ANNUAL REPORT
OF THE ASSISTANT DIRECTOR
1958 – 1959

SEPT. 1959
No. 23b

Joint Highway Research Project

by

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PURDUE UNIVERSITY
LAFAYETTE INDIANA

ANNUAL REPORT OF THE ASSISTANT DIRECTOR, 1958-1959

TO: Professor K. B. Woods, Director
Joint Highway Research Project

September 24, 1959

FROM: Professor Harold L. Michael, Assistant Director
Joint Highway Research Project

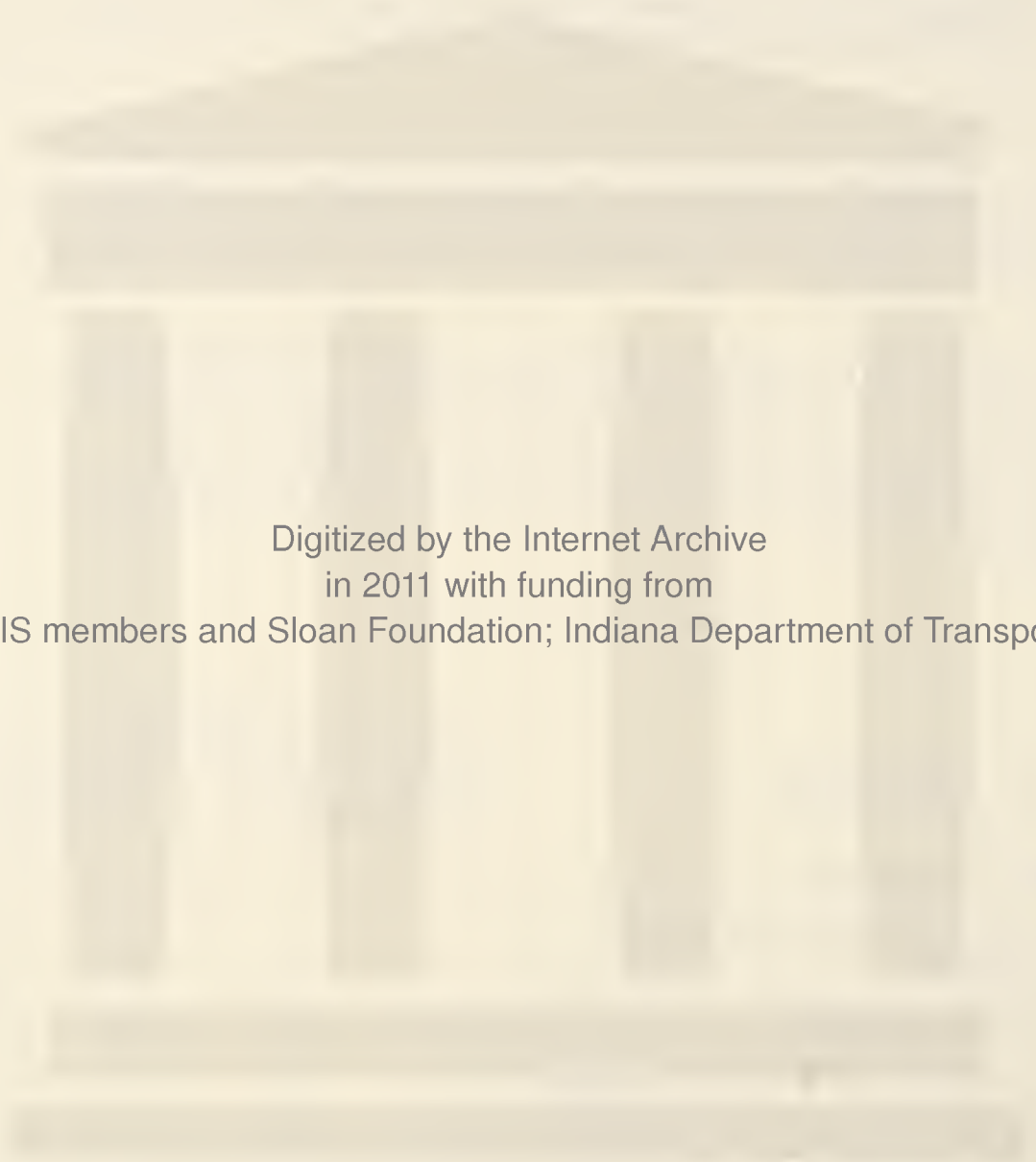
File: 10-2-3

Attached is a copy of the "Annual Report of the Assistant Director, 1958-1959". This report, the 21st in a series, presents the activities of the Joint Highway Research Project during the past year. A very brief summary of the contents of the report is included in this letter of transmittal.

The Project conducted research in nine areas during 1958-59 with forty-two (42) research projects being active. Of these studies, thirteen (13) were completed and thirteen (13) new projects were initiated. Six of the completed projects were conducted by staff members who also utilized the research in the preparation of a graduate thesis. The following table lists each of the nine areas and the distribution of active projects, completed projects, theses and new projects.

Research Projects 1958-59

Research Area	Number of Active Projects	Number of Projects Completed	Number of Theses	Number of New Projects
Airphoto Interpretation	6	1	0	2
Bituminous Materials and Flexible Pavements	8	3	0	4
Chemistry of Materials	2	1	0	0
Concrete Materials and Rigid Pavements	7	1	1	2
Economics, Administration and Finance	2	2	1	0
Soils and Pavement Design	7	2	0	3
Structures	1	1	1	0
Traffic Engineering and Safety	6	2	2	2
Special Projects	3	0	1	0
TOTAL	42	13	6	13



Fifty-six (56) formal reports were presented to the Advisory Board during the year, totaling 2,638 pages of information. Sixteen (16) of these were research reports, twenty-one (21) were technical papers, thirteen (13) were plans of study and six (6) were administrative reports.

Major research projects that were active included photographic measurement of final pay quantities in highway construction; engineering soils mapping; preparation of the atlas of county drainage maps; an evaluation of bituminous concrete by repeated load test; a study of the shear strength of bituminous mixtures; two laboratory studies of skid resistance; an observational study of the damp proofing treatment of bridges; test methods related to the alkali aggregate reaction; freezing and thawing studies of durability of concrete; studies of deleterious substances in Indiana aggregates; fatigue properties of air-entrained and light weight aggregate concrete; completion of the needs study; a study of statistical sampling for highway needs; the effect of rate of strain on the strength of remolded soil; a study of sampling of soil and statistical analysis of the results; measurements of deflections on the U. S. 31 Test Road; pressures under flexible pavements; speed studies; accident studies of slippery pavements; effect of delineation on speed patterns; a study of high-accident rates; the hydraulics of river flow under arch bridges; and the measurement of moisture gradients in concrete pavements.

Three of the research projects active during the year were cooperative projects between the Bureau of Public Roads and the State Highway Department of Indiana and utilized HPS funds in part.

Highway extension activities also continued with the 45th Annual Road School serving as the major activity. About 900 attended this conference. A classification of roads for Vigo County was completed and numerous requests for advice and assistance from counties and cities were filled.

Among many outstanding recognitions and honors received by the staff were the following: Professor Woods was National President of the American Society of Testing Materials and also continued as Chairman of the Advisory Committee for the American Association of State Highway Officials Road Test; and Professor Goetz was National President of the Association of Asphalt Paving Technologists.

No changes occurred in the personnel of the Advisory Board during the year. Advisory Board Members Hallett, Vogelgesang, Mills, Petty, Woods and Secretary Michael attended each of the eight board meetings. In fact, only a total of 14 absences at Board Meetings for the ten members and Secretary Michael were recorded during the year. On June 30, 1959, Professor Ben H. Petty and Mr. James T. Hallett, two faithful and long-time Board Members retired.

On June 30, 1959, the staff of the project consisted of twelve (12) research engineers, three (3) research associates, eight (8) research assistants, seventeen (17) graduate assistants, two (2)

service personnel, and four (4) clerical personnel - a total of forty-six (46). Twenty-two (22) staff members resigned during the year and twenty-five (25) new members were employed. In terms of years and service on the Project, Professor Petty was the oldest having first been employed on July 1, 1936. Professor Coats, employed May 13, 1938; Mr. Luthrell, employed August 6, 1938; and Professor K. B. Woods, employed February 1, 1939, have also served the project for many years.

The Project employed eighty-eight (88) extra labor employees during the year with about thirty (30) of these being employed at any one time.

Major items of equipment purchased during the year included a Tellurometer system, an electric oven, a thermo-fax machine, and a speed meter.

Members of the Staff participated in many national and international meetings. Papers were presented at national meetings of the Association of Asphalt Paving Technologists, American Road Builders Association, American Society of Testing Materials, The Highway Research Board, American Society of Civil Engineers, and American Society of Engineering Education.

Members also attended many national and state meetings of professional and educational organizations interested in transportation education and research.

Staff members presented thirty-nine (39) talks -- in addition to 39 given by Professor Woods in many locations throughout the United States - gave twenty-one (21) papers, and had twenty-six (26) publications during the year. Nine of the latter were made Civil Engineering Reprints. In addition, Professor Petty edited the Proceedings of the Road School, the 1959 Directory of Indiana State, County and City Officials and a monthly newsletter, all of which were published by the Project.

Detailed accounts of the research and the other activities are included in the report. All of these activities made possible by the fine cooperation of the staff resulted in a progressive and successful year for the Joint Highway Research Project.

Respectfully submitted,

Harold L. Michael

HLM:kmc

Harold L. Michael, Assistant Director

Attachment

cc: J. deC Ambrim, J. R. Bell, I. W. Burr, J. R. Cooper, J. W. Delleur, W. L. Dolch, K. H. Dunn, W. L. Goats, H. J. Gutzwiller, J. T. Hallett, F. F. Harvey, G. A. Hawkins, G. A. Leonards, C. W. Lovell, J. F. McLaughlin, E. D. Miles, P. E. Mills, Merle Parvis, H. H. Petty, J. H. Schaub, R. L. Schuster, M. B. Scott, C. F. Vogelgesang, J. L. Waling, R. D. Walker, J. F. Wilson, P. T. Yeh, E. J. Yoder

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Purdue University
Lafayette, Indiana

September 24, 1959

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ANNUAL REPORT OF THE ASSISTANT DIRECTOR

July 1, 1958 to June 30, 1959

INTRODUCTION

The Joint Highway Research Project in the School of Civil Engineering is organized to do cooperative research with the State Highway Department of Indiana. Research was initiated on June 1, 1936, and formally authorized by an act of the Indiana State Legislature on March 11, 1937, and amended March, 1949. The purpose of this organization is to make basic studies of materials used in highways; to facilitate economical design, construction, and maintenance of county and state highways; to investigate traffic, safety, and economics; to provide advanced instruction in the fundamentals of highway engineering and related research; and to provide practical experience in construction and maintenance procedures and use of highway materials. The Project is guided by an Advisory Board consisting of five members of the State Highway Department and six members of the staff of the School of Civil Engineering at Purdue University.

Sponsored research in the field of highway engineering is also conducted by this organization and several such projects were active during the past year.

The research conducted during the past year in the nine areas of the Project for the State Highway Department was varied and important. Forty-two (42) different research studies were in progress. Thirteen (13) of these were completed and a like number, 13, were initiated.

Fifty-six (56) formal reports were presented to the Advisory Board during the year of which sixteen (16) were detailed reports of research conducted, twenty-one (21) were technical papers prepared for publication, six (6) were administrative reports, and thirteen (13) were working plans for new or continued research. The Board received and accepted 2,638 pages of information during the year. Titles of the various reports, together with other pertinent information, are given in another section of this report.

TRANSPORTATION AND MATERIALS ENGINEERING RESEARCH

The extensive program of research that has been carried on in these fields in the past by the Project was continued and was characterized by its diversity and depth of subjects studied.

The lines of investigation covered portland cement and bituminous concrete, soils, aerial photography, traffic, transportation planning and economics, hydraulics, pavement design and structures.

The soils studies included the effect of strain rate on strength, a statistical analysis of soil sampling methods, and the deflection characteristics of flexible pavements.

The studies in the bituminous materials area were on the measurement of pavement slipperiness, the effect of mix design on slipperiness, the shear strength of bituminous mixtures under various confining conditions, and the diffusion of water vapor through bituminous materials.

In the field of portland cement and concrete, the investigations included a study of the fatigue properties of air-entrained concrete, an investigation of the effects of certain components of gravels on the durability of concrete in freezing and thawing, the determination of moisture gradients in concrete slabs, and the fatigue properties of light-weight aggregate concrete.

In the field of traffic engineering the truck speed and weight studies of past years were continued. A study of high accident situations was made and other studies were made of the effects of delineation on speed patterns and of warrants for speed zoning.

The aerial photography section was engaged in work on highway location by photogrammetry, measurement of final pay quantities by

photogrammetry, and measurement of run-off constants for small watersheds. The preparation of engineering soils maps also continued.

Studies in the general field of transportation planning and economics included the location of slippery pavements from accident reports and a study of sample survey methods for highway needs studies.

A systematic study of the hydraulic efficiency of waterways under arch bridges is being made to provide a criterion for determining the proper clear span of arch bridges so as to compensate for the loss of efficiency at high flows, and to provide a method for computing the backwater upstream of arch bridges. An analytical and experimental investigation of the mechanism of turbulence in free surface flow will be made with the test flume that has been designed and built.

As the result of a research in the Soil Mechanics area, a theory for analysing the stresses, deflections, and degree of support of concrete slabs on ground has received considerable acclaim. The theory has been recently extended to account for any combination of symmetrical, superimposed loads, and investigations to account for non-linear temperature (or moisture) gradients have been initiated.

A capacitance method for measuring moisture gradients in hardened concrete by non-destructive means was developed. It was found that the troublesome lack of sensitivity at higher moisture contents could be eliminated by the use of high frequency current. Equipment for field installations is now being investigated.

Structural research completed during the year included an experimental investigation of the effect of prestressing on the resistance of ordinary concrete to freezing and thawing. Work was continued on several projects involving theoretical and experimental studies pertinent to the development of continuously reinforced concrete pavement slabs,

and experimental research to determine the creep characteristics of concrete made of Indiana aggregates to establish the proper allowance for creep in the design of prestressed concrete structures.

Three of the research projects active during the year were cooperative research projects between the State Highway Department of Indiana and the Bureau of Public Roads. They will be conducted at Purdue University but partially financed by 1 1/2 per cent funds available to the State Highway Department. These three projects are entitled:

1. "Hydraulics of River Flow Under Arch Bridges"
2. "Measurement of Moisture Gradients in Concrete Pavements"
3. "Highway Needs From Statistical Sampling"

Important progress was made on the first two listed and the latter one was completed.

A short discussion of each research project which was active in the Project during the year is given in the next section of this report.

ACTIVE RESEARCH PROJECTS

Airphoto Interpretation Research

Research under the direction of R. D. Miles

Topographic Mapping from Airphotos (C-36-32L)

Investigator: R. D. Miles

This project is a study of the use of a Kelsh Plotter and photogrammetric techniques in the preparation of large scale topographic maps of individual bridge sites and of proposed highway locations. Maps have been made of several bridge sites at a scale of 1 inch equals 30 feet and 4 miles of road plans have been mapped at a scale of 1 inch equals 50 feet. Employees of the State Highway Department of Indiana have been trained in the use of the Kelsh Plotter during the project.

Application of Airphoto Interpretation in the Determination of Runoff Constants for Small Watersheds (C-36-32N)

Investigator: Merle Parvis

This project is an investigation of drainage basin and stream net characteristics by the use of aerial photographs to determine the values of the constants in design formulas. An attempt is being made to develop a workable procedure for the determination of waterway areas which can be applied by the bridge engineer.

Photogrammetric Measurement of Final Pay Quantities in Highway Construction (C-36-320)

Investigator: R. R. Johnson

Qualitative data are being collected photogrammetrically on a recently constructed section of highway. The photogrammetric measurements will

be used to compute various final pay items and these values will be compared with measurements secured in the field by the State Highway Department.

County Drainage Maps From Airphotos (C-36-51A)

Investigator: Merle Parvis

An Atlas of the completed 92 county drainage maps in the state of Indiana is being prepared for publication. The format has been resolved and the publication copy of county descriptions to accompany the maps has been prepared and edited. The Atlas will be available about October, 1959.

Indiana Engineering Soils Mapping (C-36-51B)

Investigator: R. Becker, J. Narain and P. T. Yeh

The object of this project is twofold: First, to investigate and to develop the airphoto patterns of different types of engineering soils in Indiana; second, to obtain a complete engineering soils map of the State. Soils of different engineering characteristics are mapped exclusively from airphotos on a county basis at a scale of 1 inch equals 1 mile. Only very limited field investigations are conducted to secure representative soil samples and to check the interpretations. Three counties are currently being mapped.

State Drainage Map (C-36-51J)

Investigator: P. T. Yeh

This is a project undertaken to prepare a State drainage map at a scale of 1/4 inch equals one mile utilizing individual detailed county drainage maps previously prepared. Fifty-four counties have been plotted to date.

Bituminous Materials and Flexible Pavement Research

Research under the direction of W. H. Goetz

Evaluation of Bituminous Concrete by Repeated Load Test on a Slab Type Specimen (C-36-6N)

Investigator: John H. Dennis

This study is to determine if the repeated-load test can be used to evaluate the stability of a bituminous concrete mixture.

Slab-type specimens are being tested in a repeated-load machine at different pressures and at specific permanent deformations. Cores are being cut from the tested portion of the specimens and density and Hveem Stabilometer tests are being made on these cores.

The Rheological Characteristics of a Sand-Asphalt Mixture (C-36-6O)

Investigator: L. E. Wood and W. H. Goetz

This is a study of the response of a sand-asphalt mixture to load applications in terms of stress-strain-time relationships. Tests were conducted on cylindrical specimens using various magnitudes of stress and different temperature levels. Modulus of recovery and mixture viscosity appear to be important mixture parameters.

Shear Strength of Bituminous Mixtures (C-36-6P)

Investigator: J. H. Schaub

Purpose of this project is to establish whether or not there is a change in the volume of a bituminous mixture tested triaxially and, if so, to establish the significant change in void content that is reflected by a change in observed shear strength. Its purpose, also is to investigate the possibility of a unique relationship between void content at failure and shear strength for bituminous mixtures prepared to a given

set of initial conditions. Additional information on the variation of the observed shear strength parameters with type of triaxial test is expected.

Properties of Bituminous Mixtures Evaluated by Hveem Stabilometer (C-36-6Q)

Investigator: R. A. Hannan

This study was an attempt to determine the applicability of the Hveem Stabilometer to the testing of open-graded bituminous mixtures. Stabilometer tests were conducted with three purposes in mind: (1) To check the validity of the Hveem displacement measurement when obtained from tests on open-graded mixtures, (2) To evaluate the limited amount of strain present in the Stabilometer test, and (3) To find out whether surface voids on the ends of specimens had a significant influence on the Hveem Stability number. Test results showed the Hveem displacement number was valid only for a relatively narrow range of Stabilometer air contents, that Stabilometer tests on very open-graded mixes did not permit sufficient strain to develop the specimen's full shearing resistance, and that stabilities were lowered when surface voids were present on the ends of test specimens.

Skid Characteristics of Bituminous Mixtures (C-36-53D)

Investigator: J. W. Shupe

Included in this study was an evaluation of the polishing characteristics of 22 mineral aggregates and a study of the relationship between the polish susceptibility and the basic properties of an aggregate. Also investigated were the effects of aggregate shape and gradation on the skid resistance of a pavement surface, and a variety of blending procedures for improving the anti-skid characteristics of a polish susceptible aggregate were tried. Work on this project also included an

evaluation of the skidding characteristics of bituminous mixtures composed of aggregates not included in the initial study, with particular emphasis on Indiana sandstone. A rather comprehensive related study was also performed on the skidding characteristics of portland cement concrete surfaces.

Laboratory Study of Skid Resistance (C-36-53J)

Investigator: Jack E. Stephens

This laboratory investigation of the effect on skid resistance of bituminous surface factors has included gradation, shape of particle, type of material, and penetration of asphalt, all as applied to fine bituminous mixes and size of surface roughness, area of aggregate, contact pressure, polish of aggregate, and edges of aggregate for general pavement surfaces. The approach used has been the preparation of specimens incorporating the desired variable and subsequent testing in a laboratory skid machine.

Bituminous Concrete Pavement Design (C-36-55E)

Investigator: W. H. Goetz

A continuing study is being made of bituminous mixture densification and change in Marshall test properties as affected by traffic. Also, a series of design tests is being performed using the Hveem Stabilometer as applied to Indiana hot-mixed base, binder and surface courses.

Tests on Cores from U. S. 31 Test Road (C-36-55F)

Investigator: N. G. Gaudette

Tests are being performed to determine height, density, and stability of the surface, binder, and base courses individually. Finally the bitumen will be extracted and submitted to the State Highway Department

of Indiana for further study. Densities were found by determining the bulk specific gravity, and stability of the mix will be determined by use of the Hveem Stabilometer.

Chemistry of Materials Research

Research under the direction of W. L. Dolch

Dampproofing Treatment of Bridges (C-36-37Z)

Investigator: W. L. Dolch

In the fall of 1956 parts of two new overpass highway bridges near Marion, Indiana were treated with a silicone solution through the courtesy of the manufacturer of the product.

The two treated bridges were observed after the first winter of exposure and no deterioration was found on either the treated or untreated parts. Continued observation has shown no durability difference between the coated and uncoated sections.

In the fall of 1958 two bridges of the Lebanon, Indiana US 52 bypass system were treated with waterproofing materials. Both a water-soluble silicone and an epoxy resin were used. Portions of each bridge were left uncoated as controls. Observation after the very severe winter of 1958-59 showed no deterioration of either treated or untreated sections.

Test Methods Related to the Alkali Aggregate Reaction (C-36-47G)

Investigator: W. L. Dolch

A method has been devised for the determination of potassium in portland cement with sodium tetraphenyl boron. This method is accurate, precise, inexpensive, and much more rapid than present gravimetric procedures. The method has been further refined and improved and this work is now complete.

Concrete Materials and Rigid Pavement Research

Research under the direction of J. F. McLaughlin

Trial of a Method for Improving the Durability of Chert (C-36-18B)

Investigator: S. Popovics

Some kinds of chert are not suitable for making concrete because they may cause deterioration of concrete when it is subjected to freezing and thawing. The purpose of this study was to try out a series of simple treatments with $CaCl_2$ and $Na_2 SiO_3$ which would decrease the water absorption characteristic of chert. The treatments seemed to be effective only if the saturation was assisted by vacuum and heat.

Durability and Deterioration of Structural Concrete (C-36-37R)

Investigator: J. F. McLaughlin

A field study of structures to determine the scope of the problems of concrete deterioration and the probable causes forms the basis of this study. The present phase is concentrated on new structures in which air-entrained concrete was used.

Field Survey of Air-entrained Concrete Pavements (C-36-37W)

Investigator: J. F. McLaughlin

This project is a continuing condition survey of concrete pavements built since the introduction of air-entrained concrete for Indiana roads. The survey is being conducted as the field phase of the evaluation of aggregate durability to obtain information helpful in setting up specification tests based on freezing and thawing of concrete.

During one year, major emphasis was placed on concrete pavements in Southwestern Indiana which were built with cherty gravels.

Evaluation of Aggregate Durability by Freezing and Thawing Tests of Concrete (C-36-37X)

Investigator: J. F. McLaughlin

This is a project consisting of the testing of aggregates in concrete subjected to freezing and thawing in automatic equipment. Aggregates from many sources have been tested to obtain information helpful in setting up better specifications for concrete aggregates.

The investigation also includes various studies of factors affecting concrete durability, such as maximum aggregate size and water/content ratio. Studies of variations in test method for freezing and thawing tests, are included.

Further Studies of Deleterious Substances in Indiana Aggregates (C-36-42F)

Investigator: R. L. Schuster

The purposes of this study are: (a) to learn more about those properties of the deleterious constituents of Indiana's aggregates which relate to the durability of concrete in which these deleterious materials are used as part of the aggregate; (b) to determine whether Indiana's present specifications on deleterious substances categorize aggregates on a realistic basis; and (c) to suggest, if possible, a simplified version of the present specifications on the basis of the conducted tests.

This investigation is being conducted primarily as a study of the durability of concrete produced from different deleterious materials in combination with a standard fine aggregate and a standard crushed stone coarse aggregate (both with good field service records), and a standard portland cement.

Fatigue Properties of Air-Entrained Concrete (C-36-56F)

Investigator: J. D. Antrim

The purpose of the investigation was to establish whether or not there is a definite distinction between the resistance to fatigue of air-entrained plain concrete and non-air-entrained plain concrete. Fatigue tests were performed at several different stress levels on specimens of two types of concrete, one containing "accidental" air and the other containing intentionally entrained air which was maintained at a constant level. Mixes were prepared periodically from each mix design so that there was little variation in the ages of the specimens being tested in fatigue.

Fatigue Properties of Light Weight Aggregate Concrete (C-36-56G)

Investigator: W. H. Gray

The purpose of this research is to determine the fatigue properties of a light weight aggregate concrete. Specimens from several mixes will be tested at various stress levels in order to determine a definite fatigue limit. It is planned to make a statistical analysis of the data obtained.

Economics, Administration and Finance Research

Research under the direction of H. L. Michael

State Highway Needs Study (C-36-54T)

Investigator: A. K. Branham, D. O. Covault, J. E. Baerwald and P. D. Cribbins

During the past three years, an engineering appraisal of the needs of the State, County and City Systems in Indiana, has been performed.

Present and future deficiencies that will occur or have occurred on these systems have been determined. Other needs of a non-fiscal nature were studied; among these needs are highway safety, classification of roads and streets, traffic engineering and the supply of engineers and technicians.

The results of this three-year study indicates the magnitude of the highway problem in Indiana, emphasizes the urban problem, and predicts that present finanical policies will not produce sufficient revenue to eliminate the needs within the next 15 years. Recommendations concerning the highway area are made. An evaluation of the relative adequacy of each section of primary and secondary rural state highways was also made.

Highway Needs From Statistical Sampling (C-36-54AA)

Investigator: D. O. Covault

The applicability of county primary road systems to sampling methods for the determination of highway needs was investigated as to:

1. The various types of sampling techniques which may be used to evaluate needs.
2. The methodology of the statistical approach to be used as applied to the highway needs problem.
3. The cost of the various types of sampling techniques which may be used.
4. The most efficient sampling techniques from the standpoint of the ease of gathering and processing data. Cost considerations were of primary importance in selecting efficient methods.

Results of this study indicated that sampling techniques were very useful and that from a practical standpoint simple random sampling was

very effective. Other techniques of sampling were also studied and their effectiveness is discussed in detail in the report.

Soils and Pavement Design Research

Research under the direction of E. J. Yoder

Effect of Rate of Strain on the Strength of Remolded Soil (C-36-14B)

Investigator: Delon Hampton

This study reports the results of a laboratory investigation of the effect of rate of strain on the strength of remolded soil. Two soils were selected for the purpose of this study - a clay and a silty clay. Both soils are native to Indiana.

Rate of strain was varied between the limits of 0.55 in./min. and 1780 in./mm. Also three compaction efforts were used and specimens were molded and tested, in unconfined compression, on both sides of optimum moisture content of each compactive effort.

The effect of the aforementioned variables upon the ultimate strength and modulus of deformation of the samples was determined. Also, applications of the relationships obtained for problems in slope stability and airport pavement design were noted.

Soil Temperature and Moisture (C-36-16A)

Investigator: E. J. Yoder

Continuous soil temperature and ground water measurements were obtained north of Lafayette for the past 12 years. These measurements have been made on a silty clay under a flexible pavement subject to normal climatic variations. Measurements were ended in August 1958 but as yet have not been analyzed.

Statistical Analysis of Soil Sampling (C-36-36A)

Investigator: Delon Hampton

This study deals with the variation in test values obtained from soil samples which represent a specific soil area. Random samples of soil are being obtained from two Wisconsin Drift areas and one Lacustrine deposit. Strength tests, classification tests, and compaction tests are being made on each. A statistical study will be made to determine the degree of variability among samples obtained from identical areas.

Flexible Pavement Design (C-36-52B)

Investigator: R. D. Walker

Field correlation studies have been undertaken for design techniques which can be adopted for Indiana. Studies will be made of failure criteria and methods of evaluating flexible pavements.

Deflection Measurements - Flexible Pavement of U. S. 31 Test Road (C-36-52C)

Investigator: R. D. Walker

Deflection patterns of the flexible test pavement (U. S. 31 south of Columbus, Indiana) are being made. Deflections will be determined for each component layer of the pavement. An analysis will be made of the fundamental properties of the pavement, and an evaluation of the factors affecting the pavement's performance will be attempted.

Soil Pressures under Flexible Pavements (C-36-52D)

Investigator: T. F. McMahon

This project consisted of two parts: Part I was concerned with the development of a pressure sensitive cell for the measurement of pressures in subgrade materials under pavements. S R-4 strain gages cemented to a flexible diaphram were used for this purpose. Part II

was concerned with the measurement, in model studies, of the pressures in a subgrade and the effects of a layered system on these pressures.

Interaction of the Effects of Certain Variables on the Stresses and Deflection of Pavements (C-36-52F)

Investigator: Byron Ruth

This study deals with theoretical stresses and deflections in flexible and rigid pavements. Numerical values of stresses and deflections are being obtained for various loads, pavement thickness, temperature conditions and subgrade types. These data will be analyzed to determine the interaction of the above variables on stresses and deflections.

Structural Research

Research under the direction of M. J. Gutzwiller

The Effect of Freezing and Thawing on Prestressed Concrete (C-36-58C)

Investigator: F. E. Musleh

The purposes of this study were: (1) to study the durability of prestressed concrete under repeated cycles of freezing and thawing, (2) to compare the freezing and thawing effect on:

a. Prestressed and ordinary concrete with an ultimate strength of 5000 psi.

b. Prestressed concrete with an ultimate strength of 5000 psi after 28 days and ordinary concrete with an ultimate strength of 3000 psi after 28 days.

The procedure used was as follows: Three batches of concrete with an ultimate strength of 5000 psi were mixed. Six beams 4 in. thick by 3 in. wide by 16 in. long were cast from each batch of concrete with four of

these beams prestressed. One batch of concrete was mixed with an ultimate strength of 3000 psi. Six beams were prepared from this mix and were stress free. All beams were subjected to many cycles of freezing and thawing and compared for deterioration rates.

Traffic Engineering and Traffic Safety Research

Research under the direction of H. L. Michael

Periodic Speed Studies (C-36-10C)

Investigator: G. E. Ingram & Donald F. Petty

Since 1941, periodic traffic speed studies have been carried out by the Joint Highway Research Project. Speeds are taken at the same stations each time of free flowing traffic on tangent sections.

In the latest study, an increase since August, 1958, of approximately one mile per hour was noted for passenger cars while truck speeds decreased approximately two miles per hour.

Truck Speed Weight Studies (C-36-10D)

Investigator: P. D. Cribbins

Annually, in August, in co-operation with the Highway Planning Survey Unit of the State Highway Department of Indiana speeds and weights of trucks are obtained. A correlation is made and the trend of speed and weight is analyzed. Indiana is one of many states conducting such a study under the national direction of the Bureau of Public Roads.

The study in August 1958 indicated that the average weight of trucks, especially heavy ones, had increased since 1957 and that the average speed of trucks, especially multiple unit ones, had increased appreciably since 1957.

Effect of Delineation on Speed Patterns (C-36-17N)

Investigator: L. D. Powers

This thesis reports the results of a study at three distinctive locations of the combined effect of various forms of delineation (roadside reflectors, pavement edge lines, signing, and, in one case, channelizing islands). The locations concerned were a narrow bridge, a hazardous intersection, and an adequate intersection, all in rural areas. Passenger car (and, at one location, truck) spot speeds were recorded at various points at each location during the day, at night, and again at night after additional delineation had been installed.

The study showed that passenger car speeds were lower at night than during daylight hours. Truck speeds, however, increased in some places and decreased in others. Variabilities of the speed distributions were not markedly changed from day to night.

The study also indicated higher night speeds on the part of passenger cars after the addition of delineation. Acceleration and deceleration were apparently delayed or diminished in the vicinity of critical features resulting, for the most part, in more uniform speed profiles through the locations. Variabilities in the speed distributions at the individual stations were largely unaffected.

Truck speeds were not markedly affected in any way, at least as far as could be determined from the limited data available.

Any differences noted, however, between speeds before and after delineation had been added were small; the average for all stations being less than plus two miles per hour. The practical significance of these differences is probably quite small.

Warrants for and Effects of Speed Zoning in Suburban Areas (C-36-17S)

Investigator: C. M. Elmberg

The study concerns the effect that different types of roadside development have upon the traveled speed and to what extent different methods of signing speed limits affects the speed. A major highway entering an urban area is being given detailed study with the hope that information on proper warrants for speed zones can be obtained. The study also includes a comparison of speed characteristics before and after major street improvements.

A Study of High Accident Rates on Certain Highways in Indiana (C-36-59D)

Investigator: H. H. Blindauer

The purpose of this study was to investigate a number of highways in Indiana having high accident rates to determine causes of the accidents and possible methods for reducing the accident rates. Certain roads were selected and divided into segments. The accidents occurring on each segment and the highway elements present on each segment were analyzed. The quality control type of analysis was used for the test sections and any out-of-control sections were closely studied for accident causes.

Approximately 8 percent of the test sections were found to be out of control. It was found that many of the accidents at these out-of-control locations were of the same type, and a specific cause for them was found at 25 of the 29 sections studied. Recommendations for reducing the accident rate at the studied locations were made. The study indicated that the quality control method of analysis was a valuable means of locating accident causes.

Locating Slippery Pavements From Accident Reports (C-36-59E)

Investigator: V. G. Stover

The purpose of this research is to investigate the possibility of using accident reports to locate "slick" sections of highway, to locate high skidding accident sites on some Indiana highways, and to attempt to establish a correlation between skidding accident rates and the slipperiness of the road surface.

Accident reports for the state highways of 10 selected counties are being analyzed to determine the number of accidents and the number of skidding accidents occurring on dry, wet, and icy road surfaces as well as the location of these accidents.

Special Research Projects

Study of Runoff from Small Drainage Areas for Highway Drainage Design in the State of Indiana (C-36-62A)

Investigator: J. W. Delleur

The purpose of the research is to study the hydrology of watersheds less than 100 square miles in area throughout the State of Indiana, to improve the existing methods for estimating the runoff from small watersheds, and to improve the present methods of design of highway drainage structures servicing small watersheds.

Hydraulics of River Flow Under Arch Bridges (C-36-62B)

Investigator: H. J. Owen, A. Sooky, and S. T. Husain

The purpose of the research is to study systematically the hydraulic efficiency of waterways under arch bridges, to provide a criterion for determining the proper clear span of arch bridges so as to compensate

for the loss of efficiency at high flows, and to provide a method for computing the backwater upstream of arch bridges. The progress of this research is summarized in a paper presented at the 45th Annual Road School at Purdue University. This report includes a dimensional analysis and a theoretical analysis of flow through semi-circular constrictions in rectangular channels. Experimental discharge coefficients and backwater depth are given for several flow conditions. These were obtained in a preliminary experimental investigation in a 12 ft. long, 6 in. wide tilting flume. This paper also reports on the design and construction of the main testing facility which includes a 64 ft. long, 5 ft. wide tilting flume.

Measurement of Moisture Gradients in Concrete Pavements (C-36-63C)

Investigator: J. R. Bell

This project is a preliminary investigation of the problem of measuring, by non-destructive test methods, moisture contents and moisture gradients in hardened portland cement concrete. The various phases of the investigation are designed to: (1) determine the requirements for a satisfactory moisture meter, (2) investigate by means of a literature study and simple laboratory tests the various methods of determing the moisture content of porous media, and (3) outline a research program for additional study of those methods worthy of intensive investigation.

The first two phases of this preliminary study have been completed. A dielectric constant or capacitance method has been selected as the most promising. Simple laboratory tests using this method indicate that it is sensitive over a wide range of water contents and has good sensitivity. An intensive study is being initiated to investigate this method in detail and to develop the necessary instruments for in-site moisture measurements.

TRAFFIC ENGINEERING SERVICES UNIT

In 1954, a unit known as Traffic Engineering Services Unit was organized within the Joint Highway Research Project at Purdue University to provide traffic and transportation engineering services for the city and county governmental units of Indiana. The services offered are primarily advice and counsel on traffic and highway problems on an extension basis. Arrangements may also be made, however, for this Unit to supervise and assist in the conduct and analysis of traffic and highway studies with the cost borne by the governmental unit concerned. The activity of the Unit during the past year has been as follows:

Item No.	Governmental Unit	Services Rendered	Status
1	West Lafayette	Advice and counsel on the traffic problems and parking needs of the city. Numerous meetings held with Citizens Committee and city officials.	Active
2	Crown Point	Advice and counsel on a thoroughfare plan and a parking plan for the city. Two reports have been made to the city.	Complete
3	Indianapolis	Assistance on traffic survey report concerning traffic on 500-mile race and qualification days.	Complete
4	Dubois County	Assisted county surveyor by advice and counsel in the preparation of a county road identification map.	Complete
5	Mishawaka	Request for assistance on Major Thoroughfare Plan received. Assistance offered in the form of advice and counsel. Not accepted to date.	Inactive
6	Jeffersonville	Request for traffic assistance received. Assistance offered. No additional action to date.	Inactive

7	Howard County	Review of zoning and subdivision control ordinance. Also inspected roads and discussed road problems in this county.	Completed
8	Rush County	Request for advice and counsel on county road problems. One visit and discussion held with county officials.	Inactive
9	Vigo County	Performed Road Classification Study as a part of a State Safety Survey of Vigo County.	Completed
10	Vanderburgh County	Request for road classification assistance. Assistance offered. One meeting held with area persons.	Active
11	Hobart	Review requested of major thoroughfare plans of Hobart. Review completed and recommendations made.	Complete
12	South Bend	Assistance on a priority study for new street construction in South Bend requested. Advice on how to do such a priority study was given.	Complete

The procedure for a city or county to obtain the services of the Unit are well established and all inquiries for services to date have been quickly fulfilled. Acceptance of some of the services has been rejected in a few cases where the city did not wish to expend the funds required.

PERSONNEL OF JOINT HIGHWAY RESEARCH PROJECT

JUNE 30, 1959

Advisory Board

C. E. Vogelgesang	(State Highway Department of Indiana), Chairman
J. R. Cooper	(State Highway Department of Indiana)
J. T. Hallett (1)	(State Highway Department of Indiana)
F. F. Havey	(State Highway Department of Indiana)
J. E. Wilson	(State Highway Department of Indiana)
K. B. Woods	(Purdue), Vice-Chairman
G. A. Leonards	(Purdue)
R. E. Mills	(Purdue)
B. H. Petty (2)	(Purdue)
J. L. Waling	(Purdue)
G. A. Hawkins (M. B. Scott)(3)	(Purdue)
H. L. Michael (4)	(Purdue), Secretary

(1) Mr. Hallett retired from State Highway Department of Indiana and the Advisory Board on June 30, 1959.

(2) Professor Petty retired from Purdue University and the Advisory Board on June 30, 1959.

(3) Professor Scott attends as representative of Dean G. A. Hawkins and is a non-voting member.

(4) Non-voting member.

Record of Meetings and Attendance

The Joint Highway Research Project Advisory Board July 1, 1958 - June 30, 1959

Meeting No.	183	184	185	186	187	188	189	190	Total to June 30, 59 (while Board Member)	
Date	July 9 1958 (5)	Sept 25 1958 (5)	Oct 23 1958 (6)	Dec 18 1958	Jan 29 1959 (7)	March 25 1959 (8)	Apr 22 1959 (9)	May 14 1959 (10)	Present	Absent
Members										
J. R. Cooper	X	X	A	X	A	X	X	X	103	10
J. T. Hallett (1)	X	X	X	X	X	X	X	X	111	8
F. F. Havey	X	X	X	X	A	X	X	A	146	10
G. A. Leonards	X	X	A	X	X	X	A	X	27	6
R. E. Mills	X	X	X	X	X	X	X	X	68	2
B. H. Petty (2)	X	X	X	X	X	X	X	X	149	25
C. E. Vogelgesang (Chm)	X	X	X	X	X	X	X	X	105	1
J. L. Waling	A	A	A	X	A	X	X	X	25	8
J. E. Wilson	X	A	A	A	X	A	A	X	11	6
K. B. Woods (V.Chm)	X	X	X	X	X	X	X	X	173	0
G. A. Hawkins (M. B. Scott)(3)	X	X	X	X	X	X	-	-	9	-
H. L. Michael (Sec'y)(4)	X	X	X	X	X	X	X	X	43	0

(1) Retired June 30, 1959.
(2) Retired June 30, 1959.
(3) Non-voting representative of Dean Hawkins. Attends when possible.
(4) Non-voting member.
(5) Professor J. M. Hayes attended for Prof. Waling.
(6) Prof. A. D. M. Lewis attended for Prof. Waling and Prof. D. E. Bloodgood attended as a guest.
(7) Professor J. E. Goldberg attended for Prof. Waling.
(8) Professor R. W. Lounsbury attended as a guest.
(9) Meeting held at AASHO Road Test, 5 guests and 6 staff members of the Project also attended.
(10) Professors R. W. Lounsbury and J. W. Delleur attended as guests.

Research Staff

Administrative Staff

K. B. Woods, Director
H. L. Michael, Assistant Director

Research Engineers

J. W. Delleur	(Hydraulics)
W. H. Goetz	(In charge, Bituminous)
M. J. Gutzwiller	(Structures)
C. W. Lovell, Jr.	(Soils)
J. F. McLaughlin	(In charge, Concrete)
R. D. Miles	(In charge, Airphoto)
Merle Parvis	(Airphoto)
B. H. Petty	(Highway Specialist)
P. T. Yeh	(Airphoto)
E. J. Yoder	(In charge, Soils)

Research Associates

A. K. Branham	(Economics)
I. W. Burr	(Statistics)
W. L. Dolch.	(In charge, Chemistry)

Research Assistants

J. deC. Antrim	(Concrete)
J. R. Bell	(Soils, Geology)
P. D. Cribbins	(Economics)
K. H. Dunn	(Soils)

D. F. Petty	(Traffic)
J. H. Schaub	(Bituminous)
R. L. Schuster	(Concrete)
R. D. Walker	(Soils)

Graduate Assistants

R. E. Becker	(Airphoto)	R. R. Johnson	(Airphoto)
J. A. Dearinger	(Traffic)	M. W. McKenzie	(Airphoto)
C. M. Elmberg	(Traffic)	H. J. Owen	(Hydraulic)
R. C. Deen	(Soils)	Sandor Popovics	(Concrete)
N. G. Gaudette	(Bituminous)	B. E. Ruth	(Soils)
W. H. Gray	(Concrete)	A. Socky	(Hydraulics)
Delon Hampton	(Soils)	V. G. Stover	(Traffic)
R. A. Hannan	(Bituminous)	L. C. Tsao	(Soils)
J. H. Haynes	(Bituminous)		

Service Personnel

E. L. Black	(Photographic and Duplicating)
W. B. Luttrell	(Shop)

Clerical Personnel

Judy Brooks	(Stenographer)
Kay Critchell	(Typist)
Gayle Pribie	(Purchasing)
Constance Wann	(Typist)

Date of Appointment of Present Staff

Name	Present Title	Appointed
Antrim, J. deC	Graduate Assistant	September 1, 1956 (A)
Becker, R. E.	Graduate Assistant	August 1, 1958
Bell, J. R.	Research Assistant	September 16, 1954 (B)
Black, E. L.	Laboratory Technician	November 1, 1953
Branham, A. K. (1)	Research Associate	September 1, 1939 (C)
Brooks, J. K.	Stenographer	June 8, 1959
Burr, I. W. (3)	Research Associate	February 1, 1958
Cribbins, P. D.	Research Assistant	February 1, 1957
Critchell, C. M.	Typist	October 6, 1958
Dearinger, J. A.	Graduate Assistant	June 1, 1959
Deen, R. C.	Graduate Assistant	September 15, 1958
Delleur, J. W. (2)	Research Engineer	July 1, 1958
Dolch, W. L. (1)	Research Associate	September 15, 1947
Dunn, K. H.	Research Assistant	September 1, 1958
Elmberg, C. M.	Graduate Assistant	September 9, 1958
Gaudette, N. G.	Graduate Assistant	September 1, 1958
Goetz, W. H. (3)	Research Engineer	May 13, 1938
Gray, W. H.	Graduate Assistant	September 1, 1958
Gutzwiller, M. J. (2)	Research Engineer	September 1, 1957
Hampton, Delon	Graduate Assistant	February 1, 1957
Hannan, R. A.	Graduate Assistant	January 1, 1959
Haynes, J. H.	Graduate Assistant	June 1, 1959
Johnson R. R.	Graduate Assistant	September 1, 1958
Lovell, C. W. (1)	Research Engineer	September 1, 1948
Luttrell, W. B.	Laboratory Assistant	August 6, 1938

McKenzie, M. W.	Graduate Assistant	June 1, 1959
McLaughlin, J. F. (1)	Research Engineer	September 1, 1950
Michael, H. L. (1)	Assistant Director	February 1, 1950
Miles, R. D. (1)	Research Engineer	September 1, 1949
Owen, H. J.	Graduate Assistant	June 1, 1958
Parvis, Merle (2)	Research Engineer	March 1, 1946
Petty B. H. (3)	Highway Specialist	July 1, 1936
Petty, D. F.	Research Assistant	February 1, 1959
Popovics, Sandor	Graduate Assistant	September 1, 1957
Pribis, Gayle	Purchasing Clerk	June 9, 1958
Ruth, B. E.	Graduate Assistant	February 1, 1959
Schaub, J. H.	Research Assistant	July 1, 1957 (D)
Schuster, R. L.	Research Assistant	February 1, 1957
Sooky, A.	Graduate Assistant	January 15, 1959
Stover, V. G.	Graduate Assistant	September 1, 1958
Tsao, I. C.	Graduate Assistant	September 1, 1958
Walker, R. D.	Research Assistant	September 15, 1953 (E)
Wann, C. D.	Typist	February 16, 1959
Woods, K. B. (4)	Director	Feburary 1, 1939
Yeh, P. T.	Research Engineer	February 1, 1953
Yoder, E. J. (2)	Research Engineer	September 1, 1949 (F)

(1) Assistant Professor (3) Professor

(2) Associate Professor (4) Head

A. Resigned May 31, 1957 and reappointed September 1, 1957, then resigned June 14, 1958 and reappointed January 22, 1959.

B. Resigned June 30, 1956 and reappointed February 1, 1958.

C. Resigned August 18, 1941 and reappointed August 1, 1949.

D. Resigned July 31, 1957 and reappointed September 1, 1958.

E. Resigned June 30, 1955 and reappointed August 1, 1957.

F. Resigned December 31, 1947 and reappointed September 1, 1949.

New Staff Members During Past Year

July 1, 1958 to June 30, 1959

Name	Rank	Degree Held	School	Date Appointed
Antrim, J. deC*	Research Assistant	BSCE 1956 MSCE 1958	Lehigh University Purdue University	January 22, 1959
Becker, R. E.	Graduate Assistant	BSCE 1952	Colorado School of Mines	August 1, 1958
Deen, R. C.	Graduate Assistant	BSCE 1951 MSCE 1958	University of Kentucky University of Kentucky	September 15, 1958
Dearinger, J. A.	Graduate Assistant	BSCE 1946 MSCE 1947	University of Kentucky University of Kentucky	June 1, 1959
Delleur, J. W.	Research Engineer	BCE 1949 MCE 1950 D. Engr.Sc. '55	Columbia University Rensselaer Polyt. Inst. Columbia University	July 1, 1958
Dunn, K. H.	Research Assistant	BSCE 1950 MSCE 1958	Missouri School of Mines Missouri School of Mines	September 1, 1958
Elmberg, C. M.	Graduate Assistant	BSCE 1956	Chalmers Univ. of Technology	September 9, 1958
Gaudette, N. G., Jr.	Graduate Assistant	BSCE 1958	St. Martins College	September 1, 1958
Gray, W. H.	Graduate Assistant	BSCE 1958	St. Martins College	September 1, 1958
Hannan, R. A.	Graduate Assistant	BSCE 1957	Purdue University	January 1, 1959
Haynes, J. H.	Graduate Assistant	BS 1956	University of Oklahoma	June 1, 1959
Ingram, G. E.**	Research Engineer	BSCE 1949 MSCE 1958	University of Arizona Purdue University	July 1, 1958
Johnson, R. R.	Graduate Assistant	BSCE 1956	Purdue University	September 1, 1958
McKenzie, M. W.	Graduate Assistant	BS 1936 BS 1937	University of Oklahoma University of Oklahoma	June 1, 1959

Name	Rank	Degree Held	School	Date Appointed
Musleh, F. E.***	Graduate Assistant	BSCE 1958	Purdue University	September 16, 1958
Narain, J.	Graduate Assistant	BS 1945 BE 1948 MSCE 1952	Lucknow University (India) Roorkee University (India) Purdue University	September 15, 1958
Petty, D. F.	Research Assistant	PME 1958	General Motors Institute	February 1, 1959
Ruth, B. E.	Graduate Assistant	BSCE 1955	Montana State College	February 1, 1959
Schaub, J. H.****	Research Assistant	BSCE 1948 SMCE 1949	Virginia Polytechnic Inst. Harvard University	September 1, 1958
Sooky, A.	Graduate Assistant	Eng.Dipl. 1956	Tech. Univ. of Budapest	January 15, 1959
Stover, V. G.	Graduate Assistant	BSCE 1958	Ohio University	September 1, 1958
Tsao, L. C.	Graduate Assistant	BS 1953	Taiwan College of Engr.	September 1, 1958
Brooks, J. K.	Stenographer			June 8, 1959
Critchell, C. M.	Typist			October 6, 1958
Mann, C. D.	Typist			February 16, 1959

* This is a reappointment; Mr. Antrim was also on the staff from September 1, 1956 to May 31, 1957 and from September 1, 1957 to June 14, 1958.

** This is a reappointment; Mr. Ingram was also on the staff from July 1, 1957 to August 31, 1957.

*** This is a reappointment; Mr. Musleh was also on the staff from February 1, 1958 to May 31, 1958.

**** This is a reappointment; Mr. Schaub was also on the staff from July 1, 1957 to July 31, 1957.

Staff Resignations During the Past Year*

July 1, 1958 to June 30, 1959

Name	Title	Degree Held	School	Appointed	Resigned
Antrim, J. deC	Graduate Assistant	BSCE 1956 MSCE 1958	Lehigh University Purdue University	9/1/57*	6/14/58
Bailey, D. H.	Graduate Assistant	BSCE 1956 MSCE 1958	Univ. of Saskatchewan Purdue University	9/1/56	9/30/58
Becker, H. E.	Graduate Assistant	BSCE 1952 MSE 1959	Colorado Sch. of Mines Purdue University	8/1/56	6/30/59
Blindauer, H. H.	Graduate Assistant	BSCE 1949 MSCE 1958	Montana State College Purdue University	9/1/57	7/31/58
Covault, D. O.	Research Engineer	BSCE 1948 MSCE 1950 PhD 1959	Purdue University Purdue University Purdue University	9/22/55	10/10/58
Deen, R. C.	Graduate Assistant	BSCE 1951 MSCE 1958	University of Kentucky University of Kentucky	9/15/58	6/30/59
Dennis, J. H.	Graduate Assistant	BS 1957	Penn State	9/1/57*	12/31/58
Green, F. H.	Research Engineer	BSCE 1926 MSCE 1947	Purdue University Purdue University	2/1/45	11/30/58
Hannan, R. A.	Graduate Assistant	BSCE 1957	Purdue University	1/1/59	6/30/59
Husain, S. T.	Graduate Assistant	BEC 1946 MSCE 1959	Osmania (India) Purdue University	2/1/58	1/31/59

Name	Title	Degree Held	School	Appointed	Resigned
Ingram, G. E.	Research Engineer	BSCE 1949 MSCE 1957	University of Arizona Purdue University	7/1/58*	8/31/58
McMahon, T. F.	Graduate Assistant	BSCE 1947 MSCE 1949 PhD 1959	Kansas State College Columbia University Purdue University	6/1/57	9/30/58
Miller, T. C.	Graduate Assistant	BSCE 1958	Duke University	6/6/58	7/31/58
Musleh, F. E.	Graduate Assistant	BSCE 1958 MSCE 1959	Purdue University Purdue University	9/16/58*	1/31/59
Narain, J.	Graduate Assistant	BS 1945 BE 1948 MSCE 1952	Lucknow Univ. (India) Roorkee Univ. (India) Purdue University	9/15/58	5/31/59
Petty, Ben H.	Highway Specialist	BSCE 1913	Purdue University	7/1/36	6/30/59**
Powers, L. D.	Graduate Assistant	BCE 1957 MSCE 1959	City College of New York Purdue University	9/16/57	5/31/59
Ruth, B. E.	Graduate Assistant	BSCE 1955 MSCE 1959	Montana State College Purdue University	2/1/59	6/30/59
Shupe, J. W.	Research Engineer	BS 1948 MSCE 1951 PhD 1958	Kansas State College Univ. of California Purdue University	5/16/58	8/31/58
Conrad, Anita (Mrs.)	Stenographer			10/2/57	6/3/59
Stewart, M. R.	Laboratory Assistant	BS 1958	Purdue University	6/1/58*	9/15/58

Name	Title	Degree Held	School	Appointed	Resigned
Treat, Helene (Mrs.)	Typist	BS 1958	Purdue University	6/9/58	11/14/58

* Date of second appointment
** Retired

Leaves of Absence

Name	Title	Degrees	School	Appointed	From	To
Branham, A. K.	Research Associate	BS 1934 MA 1938	Bradley Poly. Iowa Univ.	9/1/39	11/6/58	8/31/60
Dunn, K. H.	Research Assistant	BSCE 1950 MSCE 1958	Missouri Sch. of Mines Missouri Sch. of Mines	9/1/58	6/1/59	9/15/59

EDUCATIONAL ACTIVITIES PARTICIPATED IN BY STAFF

In addition to their research activities, many of the members of the staff of the Joint Highway Research Project served as members of the teaching staff of the School of Civil Engineering. Almost all staff members, except graduate assistants, served on the teaching staff, primarily at the graduate level, for approximately one-half of their time. In 1958-59, there were 48 students enrolled in graduate programs of study in Transportation and Materials Engineering. During this period, 19 of these were awarded advanced degrees. Six (6) of those awarded degrees - 1 Ph. D. and 5 MSCE - performed research for the Project and used the research report as their thesis. These six were distributed among the areas of the Project as follows:

Airphoto Interpretation	0
Bituminous Materials and Flexible Pavements	0
Chemistry of Materials	0
Concrete Materials and Rigid Pavements	1
Economics, Administration and Finance	1
Soils and Pavement Design	0
Structures	1
Traffic Engineering and Safety	2
Special Projects	1

In the undergraduate area, the Cooperative Program with Industry in the School of Civil Engineering had an enrollment of twenty-seven students - twelve of them with the State Highway Department of Indiana. Two participants in the program received theBachelor of Science degree in Civil Engineering in May 1959.

The School of Civil Engineering continued to assist the Division of Technical Institutes in the development of a two-year program to train highway technicians to serve as supporting personnel to civil engineers. The School of Civil Engineering also assisted the Division of Technical Institutes in the planning of an eight-week short course for highway technicians to be employed by the State Highway Department. The short course was given at the Fort Wayne, Indianapolis and Hammond Centers and on the Purdue Campus during the summer of 1958. One hundred and ten high school graduates participated in the short course.

Personnel of the Project also assisted in the area of Adult Education. The forty-fifth Annual Road School was held March 30 - April 2 and was attended by 900 persons. This years school was co-chaired by Professors J. F. McLaughlin and K. B. Woods and most of the staff of the Project participated in the many sessions. Important in this participation were the following papers and addresses delivered by staff personnel:

"Testing Open-Graded Bituminous Mixtures with the Hveem Stabilometer" by R. A. Hannan and W. H. Goetz.
"Hydraulics of River Flow Under Arch Bridges: A Progress Report" by H. J. Owen and J. W. Delleur.
"The Effects of Freezing and Thawing on Prestressed Concrete" by F. E. Musleh and W. J. Gutzwiller.
"An Analysis of High-Accident Rates" by H. H. Blindauer and H. L. Michael.
"Accomplishments and Frustrations of Forty Years' Service" by Ben H. Petty.
"Planning for County Highways: A Discussion" by H. L. Michael.
"Subgrades Bases and Stabilization: A Discussion" by E. J. Yoder.
"Bituminous Materials and Their Uses: A Discussion" by W. H. Goetz.

Mr. John W. Wheeler, Executive Assistant, Burlington Lines, Chicago, Illinois, was the recipient of "The Ben H. Petty" Award, given for the second time at the last Road School.

Assistance was also given by members of the Project staff to a Conference on Downtown Parking in September 1958 and to other conferences sponsored by the School of Civil Engineering and the Purdue Public Safety Institute.

MAJOR RESEARCH EQUIPMENT PURCHASED

Important items of equipment added during the year included the following:

Item	Approximate Cost	Laboratory
Tellurometer System	$ 8,000	Airphoto
Electric Oven	$ 1,000	Bituminous
Speed Meter	$ 700	Traffic
Vary-Tally Counters	$ 380	Traffic
Model Flume	$10,000	Hydraulics
Thermo-Fax Equipment	$ 400	Office

In addition the mechanical kneading compactor in the Bituminous Laboratory was placed into operation during the year and laboratory equipment valued at $3,000 for the testing of slipperiness characteristics of pavements was further developed and extensively used.

OTHER PROFESSIONAL ACTIVITIES OF STAFF

Members of the Project staff maintained their active and broad interest in state and national engineering activities during 1958-59. Some of these activities in which members participated are given in the following paragraphs.

A meeting of the Association of Asphalt Paving Technologists was held in Denver, Colorado on January 25-28, 1959 and was attended by Professors W. H. Goetz and L. E. Wood. Professor Goetz, who was National President of the Association, presented a paper entitled "Rheological Characteristics of Sand Asphalt Mixtures."

The American Concrete Institute meeting in Los Angeles was attended by Professors J. L. Waling and M. J. Gutzwiller. They presented two papers at this meeting entitled "Laboratory Research on Pavements Reinforced with Deformed Bars" and "Stresses and Deflections in Concrete Pavements Continuously Reinforced with Deformed Bars."

The American Railway Engineering Association held several meetings during the year. Professor W. L. Dolch attended one on June 9 in Chicago and presented a paper on "Effect of Weathering on Wetting of Bituminous Emulsion Films by Water." At a March 10 meeting Professor K. B. Woods presented a paper entitled "Soil Engineering Problems on the Quebec, North Shore and Labrador Railway." This paper was co-authored by R. W. J. Pryer and W. J. Eden. Professor Michael also attended the meeting on March 10 and a meeting of Committee 9 - Highways on March 9.

The American Road Builders Association held its annual meeting in Dallas, Texas, January 19-23, 1959. Professor B. H. Petty attended. Professor Petty also attended the meeting of the Educational Division, ARBA, which was held in Washington D. C. on April 16, 1959.

The American Society of Engineering Education held its annual meeting in Pittsburgh, Pennsylvania June 15-19, 1959. Among staff members from the Civil Engineering School attending this meeting were the following from the Project staff: W. H. Goetz, J. L. Waling and K. B. Woods with the latter presenting a paper entitled "Integration of Research Programs with the Teaching of Transportation Engineering."

Professors W. H. Goetz and K. B. Woods were present at the American Society for Testing Materials meeting in Pittsburgh on February 2-7, 1959.

At the American Society for Testing Materials meeting in Atlantic City, New Jersey, June 22-23, 1959, the following staff members were present: J. H. Schaub, W. H. Goetz, J. F. McLaughlin, G. A. Leonards, W. L. Dolch and K. B. Woods. The following formal papers were presented:

"Triaxial Testing of Bituminous Mixtures" by W. H. Goetz and J. H. Schaub
"Time Effects on the Consolidation of Clay" by G. A. Leonards
"Studies of Limestone Aggregates by Fluid Flow Methods" by W. L. Dolch
"Impact of Science on ASTM" by K. B. Woods
"Symposium on Impact of the Development in Materials Sciences on Engineering Education" by K. B. Woods.

Professor Woods also served as President of the American Society for Testing Materials during the past year. He was presiding officer of the ASTM Board of Directors Meetings held in Philadelphia, Pennsylvania on several occasions and spoke at many universities and joint meetings throughout the United States. Topics included "Polar Construction," "Trends in Engineering Curriculum," and "Highway Research." Following is a list of the places and dates of the presentation of these papers.

Polar Construction

University of Florida, October 6, 1958

University of Tennessee, October 9, 1958

University of Kentucky, October 10, 1958

MIT Faculty Club, October 30, 1958

Young Scientists Club, Muncie, Ind., November 10, 1958

RPI, Troy, New York, November 17, 1958

Villanova, Philadelphia, Pennsylvania, November 20, 1958

New York District, ASTM, New York City, January 13, 1959

Southwest District, ASTM, Houston, Texas, February 26, 1959

Southern Methodist University, Dallas, Texas, March 3, 1959

University of Utah, March 6, 1959

Caltech, Los Angeles, March 9, 1959

Joint SWA and ASCE Meeting, Fisherman's Wharf, San Francisco, March 10, 1959

Rotary Club, Richland, Washington, March 17, 1959

Chicago District, ASTM, March 23, 1959

Iowa State College, Ames, Iowa, April 14, 1959

Joint ASCE Meeting, Purdue, April 21, 1959

Civil Engineering Sophomores, Purdue, April 28, 1959

ASTM, Detroit, Michigan, April 29, 1959

Pittsburgh, Pennsylvania District ASTM, April 30, 1959

Lafayette Lions Club, June 3, 1959

Annual Meeting, ASTM, Atlantic City, New Jersey, June 23, 1959

Highway Research

Industrial Development Conference, Purdue, September 26, 1958

ASTM, Georgia Institute of Technology, October 8, 1958

ASTM District Meeting, Washington, D. C., November 19, 1958

Highway Engineers, Dover, Delaware, January 12, 1959

Engineering Staff, University of Washington, Seattle, March 13, 1959

Engineering Curricula

Engineering Faculty, University of Virginia, Charlottesville, September 12, 1958

Engineering Faculty, University of Kentucky, October 10, 1958

Engineering Faculty, Rice Institute, February 25, 1959

District Meeting ASTM, College Station, Texas, March 2, 1959

District Meeting ASTM, University of Oklahoma, Norman, March 4, 1959

Engineering Staff, Caltech, Los Angeles, March 10, 1959

Engineering Staff, University of California, Berkeley, March 11, 1959

Richland, Washington, March 17, 1959

Engineering Staff, Iowa State College, Ames, April 14, 1959

Civil Engineering Sophomores, Purdue, April 21, 1959

Engineering Staff, University of Illinois, May 12, 1959

A meeting of the Institute of Traffic Engineers was attended by Professor H. L. Michael in Miami, Florida on November 10-14, 1958.

The Highway Research Board meeting in Washington, D. C., held January 4-8, 1959 was attended by the following Civil Engineering staff members:

P. D. Cribbins
W. L. Dolch
W. H. Goetz
M. J. Gutzwiller
D. Hampton
M. E. Harr
G. A. Leonards
C. W. Lovell
H. L. Michael
L. D. Powers
J. H. Schaub
J. L. Waling
E. J. Yoder
R. D. Walker
K. B. Woods

Formal papers concerning Project research were presented by the following:

Professor Yoder, "Effect of Rate of Rate of Strain on Strength of Compacted Soils" (Co-authored by Delon Hampton)

Mr. R. D. Walker, "Effect of Maximum Size of Coarse Aggregate on Portland Cement Concrete for Highway Pavements" (A bibliography)

Professor W. H. Goetz, "A Laboratory Investigation of Pavement Slipperiness" (Co-authored by J. W. Shupe)

Mr. M. M. Miller "The Mechanics of Continuously Reinforced Concrete Pavements" (Co-authored by M. J. Gutzwiller)

Professors G. A. Leonards and M. E. Harr, "Warping Stresses and Deflections in Concrete Pavements"

Professor W. H. Goetz attended the meeting of the Bituminous Division of the Highway Research Board on August 19, 1958 in St. Louis, Missouri. Professors Leonards and Harr also presented a paper "Analysis of Concrete Slab on Ground" At the American Society of Civil Engineers meeting in Cleveland on May 11-14, 1959.

Professor J. F. McLaughlin on May 20-22, 1959 attended the Jet Airport Conference of the American Society of Civil Engineers in Houston, Texas.

Mr. P. D. Cribbins attended the Bituminous Plant Mix Concrete School in Raleigh, North Carolina on February 23, 1959.

The Virginia Soil Mechanics Conference held in Charlottesville, Virginia March 25-27, 1959 was attended by Professor E. J. Yoder who presented a paper on "Stabilization."

The Geological Society of America Meeting was held in St. Louis, Missouri on November 6-8, 1958 and was attended by E. J. Yoder and R. L. Schuster of the Project staff .

The First International Skid Conference in Charlottesville, Virginia was attended by Professors H. L. Michael, W. H. Goetz, K. B. Woods and Dr. John Shupe, the latter presenting a paper on "Polishing Characteristics of Aggregates." Professor Michael talked on "Effect of Pavement Type and Composition on Slipperiness--A Summary of Research in Indiana."

Professor K. B. Woods, Head of the Civil Engineering School, presided at this meeting. The state skid-testing equipment which was developed in the Project, participated in a Correlation Study and proved to be very reliable.

Professor R. D. Miles attended the American Congress on Surveying and Mapping and the American Society of Photogrammetry meetings inWashington, D. C. on March 9-12, 1959.

The Ontario Good Roads Association of Toronto, Ontario held a meeting on February 24, 1959 at which Professor J. F. McLaughlin presented a paper entitled "Road Schools in the U.S.A"

A meeting of the National Conference on Fundamental Research in Plain Concrete was held in Allerton Park, Illinois in September 1958 and was attended by Professor J. F. McLaughlin, who gave a paper on "Research on Concrete Durability." Professor W. L. Dolch also attended and presented a paper entitled "Chemical Aspects of Concrete."

Professor Goetz presented a paper entitled "Asphalt Materials and Their Use in Road Construction" November 3 at an Asphalt Conference at Marquette University.

Mr. Robert Schuster was invited to attend the National Science Foundation College Teacher's Conference for geology teachers at Oregon State College June 15-27, 1959. The Conference consisted of a week of lectures and discussion on the Oregon State campus and a week of field trips throughout the state of Oregon.

Professor Woods also attended meetings of the Highway Research Board, Frost Heave and Frost Action Committee in Ottawa, Canada, on August 25-26, 1958; Pan American Society, as a representative of ASTM, in Montreal, Canada on September 1-2, 1958; and several meetings of the AASHO Road Test Advisory Committee at Ottawa, Illinois. Professor Woods continued to serve during the year as Chairman of the latter group.

Numerous members of the staff continued to serve on Departments and Committees of the Highway Research Board.

Members of the staff also participated in numerous state and local meetings of several technical societies. These included the Indiana Society of Professional Engineers and its Lafayette Chapter, the Indiana Section of the American Society of Civil Engineers, the Indiana Section of the Institute of Traffic Engineers, and the local section of the American Society of Engineering Education.

Thirty-nine (39) talks were also presented by members of the Project staff during the year to professional groups, civic organizations and others.

Several members of the staff also performed service of a civic nature by membership on several Citizens Committees of West Lafayette, Indiana.

PUBLICATIONS

Papers, Bulletins, Reprints, and Theses

July 1, 1958 to June 30, 1959

Research Activities Bulletins-Engineering Experiment Station *
(From January 1936 to date)

EES Bull.	Vol.	No.	Date	Publications (inclusive)	Period Covered
83	25	5	Sept. 1941	1P - 45P	Jan. 1936 - June 1941
85	26	4	July 1942	46P - 60P	July 1941 - June 1942
91	27	6	Nov. 1943	61P - 73P	July 1942 - June 1943
94	29	1	Jan. 1945	74P - 91P	July 1943 - June 1944
96	29	4	July 1945	92P - 103P	July 1944 - June 1945
100	31	1	Jan. 1945	104P - 124P	July 1945 - June 1946
102	31	5	Sept. 1947	119P - 157P	July 1946 - June 1947
107	33	1	Jan. 1949	158P - 176P	July 1947 - June 1948
110	34	2	Mar. 1950	177P - 212P	July 1948 - June 1949
113	35	4	July 1951	213P - 243P	July 1949 - June 1950
116	36	3	May 1952	244P - 272P	July 1950 - June 1951
119	37	3	May 1953	273P - 307P	July 1951 - June 1952
120	37	6	Nov. 1953	308P - 345P	July 1952 - June 1953
122	38	6	Nov. 1954	346P - 374P	July 1953 - June 1954
126	39	6	Nov. 1955	375P - 400P	July 1954 - June 1955
132	40	4	Dec. 1956	401P - 442P	July 1955 - June 1956
136	41	4	Dec. 1957	443P - 472P	July 1956 - June 1957
139	43	1	Mar. 1959	473P - 509P	July 1957 - June 1958

* Also see EES Bulletin No. 99 which covers a complete listing of publications 1-122P. These Bulletins contain summaries of the various research projects as well as some information on the publications by the staff. The Abstracts Bulletin initiated in 1956 contains a short abstract of each staff publication or thesis.

Abstracts of Engineering Staff Publications and Theses
(From 1956 to date)

EES Bull.	Vol.	No.	Date	Includes Publications	Period
133	41	1	March 1957	401P - 442P	July 1955 - June 1956
137	42	1	March 1958	443P - 472P	July 1956 - June 1957
140	43	2	June 1959	473P - 509P	July 1957 - June 1958

Reprints

510P "A Laboratory Method for Determining the Skidding Resistance of Bituminous Paving Mixtures," by J. W. Shupe and W. H. Goetz, Proceedings of the American Society for Testing Materials, Vol. 58, pp. 1-24, 1958. (Civil Engineering Reprint No. 142.)

511P "Triaxial Testing of Bituminous Mixtures at High Confining Pressures," by J. C. Oppenlander and W. H. Goetz, Proceedings of the Highway Research Board, Vol. 37, pp. 201-218, 1958. (Civil Engineering Reprint No. 143.)

512P "Quality Aggregates for Indiana Highways," by K. B. Woods, J. F. McLaughlin, and R. L. Schuster, Proceedings of the 44th Annual Purdue Road School, Extension Series No. 95, Vol. 42, No. 4, pp. 81-94, December 1958. (Civil Engineering Reprint No. 145.)

513P "The Value of Planned Access on Urban Bypasses," by Charles Pinnell and H. L. Michael, Proceedings of the 44th Annual Purdue Road School, Extension Series No. 95, Vol. 42, No. 4, pp. 100-115, December 1958. (Civil Engineering Reprint No. 146.)

514P "The Effect of Rate of Strain on Soil Strength," by Delon Hampton and E. J. Yoder, Proceedings of the 44th Annual Purdue Road School, Extension Series No. 95, Vol. 42, No. 4, pp. 116-129, December 1958. (Civil Engineering Reprint No. 147.)

515P "The Relationship Between the Unconfined Compressive Strength of a Bituminous Mixture and Viscosity of the Binder," by L. E. Wood and W. H. Goetz, Proceedings of the Association of Asphalt Paving Technologists, Vol. 27, pp. 563-580, 1958. (Civil Engineering Reprint No. 148.)

516P "Correlation Between Concrete Durability and Air-void Characteristics," by F. K. Fears, Bulletin 196, Highway Research Board, pp. 17-28, 1958. (Civil Engineering Reprint No. 151.)

517P "Fatigue Study of Air-Entrained Concrete," by J. deC. Antrim and J. F. McLaughlin, Journal of the American Concrete Institute, Vol. 30, No. 11, pp. 1173-1182, May 1959. (Civil Engineering Reprint No. 156.)

518P "Effect of Base Course Gradation on Results of Laboratory Pumping Tests," by W. P. Chamberlin and E. J. Yoder, Bull. 202, Highway Research Board, pp. 59-79, 1958. (Civil Engineering Reprint No. 157.)

Theses

519P "A study of the Fatigue Properties of Air-Entrained Concrete," A thesis submitted to the faculty of Purdue University by John deCourcy Antrim in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, January 1959.

520P " A Study of High Accident Rates on Certain Highways in Indiana," A thesis submitted to the faculty of Purdue University by Harlan Healy Blindauer in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, January 1959.

521P "Preliminary Model Investigation of Hydraulic Characteristics of River Flow under Arch Bridges," A thesis submitted to the faculty of Purdue University by Syed Tahir Husain in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, January 1959.

522P "The Effects of Freezing and Thawing on Prestressed Concrete," A thesis submitted to the faculty of Purdue University by Fouad Elyas Musleh in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, January 1959.

523P "Estimation of Highway Needs for County Primary Road Systems by Sample Survey Methods," A thesis submitted to the faculty of Purdue University by Donald Orville Covault in partial fulfillment of the requirements for the degree of Doctor of Philosophy, January 1959.

524P "A Study of the Effect of Delineation of Traffic Speed Patterns, A thesis submitted to the faculty of Purdue University by Lawrence David Powers in partial fulfillment of the requirements for the degree of Master of Science in Civil Engineering, May 1959.

Other Publications
(See also list of Reprints)

525P "Triaxial Testing of Open Type Bituminous Mixtures," by J. C. Oppenlander and W. H. Goetz, Proceedings, Association of Asphalt Paving Technologists, Vol. 27, 1958, pp. 232-264.

526P "Method of Testing for Water Resistance of Bituminous Paving Mixtures," by W. H. Goetz, Proceedings, Special Technical Publications No. 240, American Society of Testing Materials, 1958, pp. 84-94.

527P "Analysis of Concrete Slabs on Ground," by G. A. Leonards and M. E. Harr, Journal of Soil Mechanics and Foundations, American Society of Civil Engineering, Vol. 85, SM3, June 1959.

528P "Mineral Aggregates," by J. F. McLaughlin, Highway Research Board Bibliography #23, 1958, Revision, Publication 631, 1958.

529P "Application of Pulse Velocity Tests to Several Laboratory Studies of Materials," by J. F. McLaughlin and K. B. Woods, Highway Research Board Bulletin 206, National Academy of Sciences - National Research Council Publications 639, 1959, 27 pages.

530P Proceedings, edited by J. F. McLaughlin, Conference on Downtown Parking, Purdue, September 1958, 46 pages.

531P "How to Improve Parking in Your City," by H. L. Michael, Proceedings, Conference on Downtown Parking Purdue, September 1958, pp. 29-37.

532P "Experience with Core Drilling Machines, Power Augers, and Electrical Resistivity on the Pennsylvania Turnpike," by D. G. Shurig and E. J. Yoder, American Society of Testing Materials, Technical Publication #239, 2 pages.

533P "Effects of Base Course Gradation on Results of Laboratory Pumping Tests," by W. P. Chamberlin and E. J. Yoder, Proceedings, Highway Research Bulletin 202, p. 20.

534P "Soil Engineering Problems on the Quebec North Shore and Labrador Railway," by K. B. Woods, R. W. J. Pryer and W. J. Eden, Bulletin 549, Vol. 60, American Railway Engineering Association, pp. 669-688, February, 1959.

535P "Investigation of Banded Sediments Along St. Lawrence North Shore in Quebec," by R. W. J. Pryer and K. B. Woods, Special Technical Publication No. 239, American Society for Testing Materials, pp. 55-70, 1958.

Note 1. In addition, "Proceedings of the 44th Annual Purdue Road School," Extension Series No. 92, Vol. 42, No. 4, December 1958, 182 pp.; "1959 Directory, Indiana State, County, and City Highway Officials," 27 pp.; and "Highway Extension News" monthly, 12 issues, 2 pp. or more, each were edited by B. H. Petty and published by the Joint Highway Research Project.

JOINT HIGHWAY RESEARCH PROJECTS AND ADVISORY BOARD REPORTS
July 1, 1958 to June 30, 1959

Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
962 - Proposed Budget for Period July 1 - September 30, 1958	---	Michael	7/9	5	0	130	XX	3	A	12
963 - Final Report "Effect of Rate of Strain on the Strength of Remolded Soil" (1958 JHRP Report No. 17)	14B	Hampton	7/9	79	16	130	XX	3	A	17
964 - Final Report "The Preliminary Location of a Proposed Highway by Photogrammetric Surveys" (1958 JHRP Report No. 18)	32M	Bailey	7/9	182	34	130	XX	3	A	96
965 - Final Report "A Study of the Fatigue Properties of Air-Entrained Concrete" (1958 JHRP Report No. 19)	58B	Antrim	7/9	157	9	130	XX	3	A	278
966 - Final Report of Needs Study, "A Study of Highway Transportation in Indiana" (Revised)	54T	Michael Branham Covault Baerwald Cribbins	9/25	223	69	131	XX	3	B	23
967 - Proposed Budget for Period October 1 - December 31, 1958	---	Michael	9/25	7	0	131	XX	3	B	246
968 - Technical Paper "A Laboratory Method of Evaluating Slipperiness" (1958 JHRP Report No. 21)	53D	Shupe Goetz	9/25	24	9	131	XX	3	B	254
969 - Technical Paper "Polishing Characteristics of Mineral Aggregates" (1958 JHRP Report No. 22)	53D	Shupe Lounsbury	9/25	49	9	131	XX	3	B	278

	Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
970 -	Memorandum "Skid Resistance Values of Indiana Sands"	53		9/25	7	0	131	XX	3	B	327
971 -	Progress Report No. 1 "Further Studies of Indiana Gravels"	52D	Schuster McLaughlin	9/25	20	9	131	XX	3	B	334
972 -	Progress Report "Traffic Speed Report No. 64, Truck Weight - Speed Study" (1958 JHRP Report No. 23)	10D	Cribbins	9/25	18	6	131	XX	3	B	354
973 -	Progress Report "Traffic Speed Report No. 65" (1958 JHRP Report No. 24)	10C	Ingram	9/25	19	7	131	XX	3	B	372
974 -	Final Report "A Study of High Accident Rates on Certain Highways in Indiana" (1958 JHRP Report No. 20)	59D	Blindauer	9/25	83	20	131	XX	3	B	391
975 -	Final Report "Major Thoroughfare and Parking Study, Crown Point, Indiana"	---	Traffic Engineering Services Unit	9/25	23	3	131	XX	3	B	474
976 -	Technical Paper "Experience with Core Drilling Machines, Power Auger, and Electrical Resistivity on the Pennsylvania Turnpike" (1958 JHRP Report No. 25)	36E	Shurig Yoder	9/25	41	10	131	XX	3	B	497
977 -	Informational Report "Trial of a Method for Improving the Durability of Chert" (1958 JHRP Report No. 27)	18B	Popovics	10/23	21	1	132	XX	4	A	24
978 -	Plan of Study "Alkali Reactivity Studies of Indiana Gravels"	47G	Dolch	10/23	6	0	132	XX	4	A	45
979 -	Technical Paper "Study of the Fatigue Properties of Air-Entrained Concrete" (1958 JHRP Report No. 26)	58B	Antrim McLaughlin	10/23	28	2	132	XX	4	A	51

	Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
980 -	Administrative Report "Annual Report of Assistant Director, 1957 - 1958" (1958 JHRP Report No. 28)	---	Michael	10/23	77	0	132	XX	4	A	79
981 -	Proceedings of Conference on Parking, Purdue University, Lafayette, Indiana, September 1958	---	---	12/18	48	0	132	XX	4	A	164
982 -	Proposed Budget for the Period January 1 - March 31, 1959	---	Michael	12/18	8	0	132	XX	4	A	212
983 -	Plan of Study "Statistical Analysis of Soil Sampling"	36A	Hampton	12/18	8	0	132	XX	4	A	220
984 -	Technical Paper "Effect of Rate of Strain on the Strength of Compected Soil" (1958 JHRP Report No. 31)	14B	Yoder Hampton	12/13	45	9	132	XX	4	A	228
985 -	Technical Paper "A Laboratory Investigation of Pavement Slipperiness" (1958 JHRP Report No. 32)	53D	Shupe Goetz	12/18	52	15	132	XX	4	A	273
986 -	Technical Paper "The Mechanics of of Continuously Reinforced Concrete Pavements" (1958 JHRP Report No. 30)	46M	Miller Gutzwiller	12/18	35	10	132	XX	4	A	325
987 -	Final Report "Estimation of Highway Needs for County Primary Road Systems in Michigan and Minnesota by Sample Survey Methods" (1958 JHRP Report No. 29)	54AA	Covault	12/18	393	56	132	XX	4	A	364
988 -	Plan of Study "Application of Airphoto Interpretation in the Determination of Runoff Constants for Small Watersheds"	32N	Parvis	1/29	9	0	133	XXI	1	A	13

	Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg
989	Plan of Study "Fatigue Properties of Light Weight Aggregate Concrete"	56G	Gray	1/29	10	0	133	XXI	1	A	20
990	Progress Report No. 1, "The Feasibility of Measuring the Moisture Gradients in Concrete Pavement Slabs" (1959 JHRP Report No. 3)	63C	Bell	1/29	67	11	133	XXI	1	A	30
991	Technical Paper "The Rheological Characteristics of a Sand-Asphalt Mixture" (1959 JHRP Report No. 1)	6M	Wood Goetz	1/29	30	11	133	XXI	1	A	98
992	Technical Paper "Warping Stresses and Deflections in Concrete Pavements" (1959 JHRP Report No. 2)	63B	Harr Leonards	1/29	23	13	133	XXI	1	A	128
993	Informational Report "The Factor of Moisture in Frost Action" (1959 JHRP Report No. 5)	---	Low Lovell	1/29	44	9	133	XXI	1	A	181
994	Informational Report "Uniformity of Signs, Signals, Markings, and Rules of the Road in the States of the Midwestern Area"	---	Michael	1/29	23	0	133	XXI	1	A	225
995	Bibliography "The Effect of Maximum Size of Coarse Aggregate on Portland Cement Concrete for Highway Pavements"	---	Walker	1/29	12	0	133	XXI	1	A	248
996	Plan of Study "Locating Slippery Pavements from Accident Records"	59E	Stover	3/25	10	0	133	XXI	1	A	268
997	Plan of Study "Interactions of the Effects of Certain Variables on the Stresses and Deflections of Pavements"	52F	Yoder	3/25	4	0	133	XXI	1	A	278

	Report and No.	Proj. C-36	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
998 -	Plan of Study "Warrants for and Effects of Speed Zoning in Urban Areas"	178	Elmberg	3/25	10	0	133	XXI	1	A	282
999 -	Plan of Study "Deflection Measurements Flexible Pavements - Test Road U. S. 31"	520	Walker	3/21	13	5	133	XXI	1	A	292
1000 -	Informational Report "Effect of Moisture Content of Aggregate on the Properties of Bituminous Concrete"	158	Popovics	3/25	11	0	133	XXI	1	A	307
1001 -	Final Report "The Effect of Freezing and Thawing on Prestressed Concrete" (1959 JHRP Report No. 4)	49	Mueller	3/25	97	29	133	XXI	1	A	322
1002 -	Proposed Budget for Period April 1 - June 30, 1959	---	Michael	3/25	4	0	133	XXI	1	A	410
1003 -	Final Report "Vigo County Highway Classification"	---	Miles	3/25	13	0	133	XXI	1	A	414
1004 -	Progress Report "Experimental Water proofing Treatments of Two Bridges on the Lebanon By Pass"	37%	Deich	3/25	6	2	133	XXI	1	A	431
1005 -	Technical Paper "Triaxial Testing of Bituminous Mixtures" (1959 JHRP Report No. 6)	6	Schmidt Coetz	3/25	51	18	133	XXI	1	A	437
1006 -	File Guide and File Index	---	Michael	3/25	51	0	133	XXI	1	A	470
1007 -	Plan of Study "Photogrammetric Measurement of Final Pay Quantities In Highway Construction"	320	Johnson	5/14	11	0	134	XXI	2	A	7

	Report and No.	Proj. C-136	Author	Date	Pages	Figs.	Bk.	Vol.	No.	Pt.	Pg.
1008 -	Plan of Study "Shear Strength of Bituminous Mixtures"	6D	Schaub	5/14	13	0	134	XXI	2	A	18
1009 -	Progress Report "Laboratory Study of Skid Resistance"	53J	Stephens	5/14	10	0	134	XXI	2	A	31
1010 -	Progress Report "Traffic Speed Report No. 66" (1959 JHRP Report No. 10)	10C	Petty	5/14	21	8	134	XXI	2	A	41
1011 -	Final Report "A Study of the Effect of Delineation on Traffic Speed Patterns" (1959 JHRP Report No. 11)	17N	Powers	5/14	115	19	134	XXI	2	A	62
1012 -	Technical Paper "Hydraulics of River Flow Under Arch Bridges- A Progress Report" (1959 JHRP Report No. 12)	62B	Owen Sooky Husain Delleur	5/14	36	11	134	XXI	2	A	177
1013 -	Technical Paper "An Analysis of High Accident Rates" (1959 JHRP Report No. 14)	59D	Blindauer Michael	5/14	26	9	134	XXI	2	A	213
1014 -	Technical Paper "The Effects of Freezing and Thawing on Prestressed Concrete" (1959 JHRP Report No. 13)	58C	Musleh Gutzwiller	5/14	32	9	134	XXI	2	A	239
1015 -	Technical Paper (Information) "Laboratory Research on Pavements Continuously Reinforced with Welded Wire Fabric"	---	Gutzwiller Waling	5/14	31	8	134	XXI	2	A	271
1016 -	Technical Paper (Information) "Crack Formation in Continuously Reinforced Pavements"	---	Gutzwiller Waling	5/14	39	11	134	XXI	2	A	302
1017 -	Technical Paper (Information) "Stresses and Deflections in Concrete Pavements Continuously Reinforced with Welded Wire Fabric"	---	Gutzwiller Waling	5/14	51	15	134	XXI	2	A	341

SUMMARY TABULATION OF RESEARCH PROJECTS

Status as of June 30, 1959

KEY TO STATUS NUMBERS

Key Number	
1	Complete--unpublished
2	Complete--published (including completed theses).
3	Incomplete--inactive.
4	Complete--publication in progress.
5	Active--incomplete.
6	Being started.
7	Planned.

* Resigned

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
1	6-3	Jackson*	2	Test Road No. 1, old series
2	6-4	Jackson*	2	Test Road No. 1, new series
3	6-5	Jackson*	2	Test Road 2
4	2-3			Surface Treatment
	2-3-1	Shelburne*	2	A--1935 & Older Construction
	2-3-2	Shelburne*	2	B--1936 Construction
	2-3-3	Shelburne*	2	C--1937 Construction
5	6-6			Laboratory Soil Studies
	6-6-1	Graves*	1	A--Durability
	6-6-2	Winn*	2	B--Frost Action
	6-6-3	Kay*	2	C--Permeability
	6-6-4	Mayo*	2	D--Compression
	6-6-5	Schaub	3	E--Compaction on Remolded Clays
6	2-4			Bituminous Mixtures
	2-4-1	Graves*	3	A--Pugmill
	2-4-2	Graves*	1	B--Patch Materials
	2-4-3	Graves*	3	C--Unconfined Compression Tests
	2-4-4	Layman*	2	D--Unconfined Compression & Squeeze Tests
	2-4-5	Chen*	2	E--Stability
	2-4-6	McLaughlin	2	F--Resurface Mixtures
	2-4-7	Herrin*	2	G--Particle Shape
	2-4-8	Havers* & Dusenbury*	2	H--Rubber Asphalt
	2-4-9	Osili*	2	I--Seal Coats

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	2-4-10	Wood	2	J--Str. & Deform. Charac.
	2-4-11	Oppenlander*	2	K-Triaxial Testing at High Pressure
	2-4-12	Zegarra*	2	L--Aggregate Bitumen Mixtures
	2-4-13	Goetz	2	M--Strength by Marshall Test
	2-4-14	Dennis	5	N--Repeated Load Test Evaluation
	2-4-15	Wood	2	O--Rheological Characteristics
	2-4-16	Schaub	5	P--Shear Strength
	2-4-17	Hannen	2	Q--Testing - Hveem Stabilometer
7	2-5			Rock Asphalt
	2-5-1	Goetz, Tyler*	2	A--Exploratory Study
8	2-6			Bituminous Adhesion
	2-6-1	Goetz	2	A--Untreated
	2-6-2	Tyler*	3	B--Treated
	2-6-3	Andersland*	2	C--Sonic Test Evaluation
9	5-3			Aggregate Degradation
	5-3-1	Shelburne*	2	A--Under Road Rollers
10	8-3			Traffic Speeds
	8-3-1	Lawshe*	2	A--Bibliography
	8-3-2	Branham	2	B--Equipment Development
	8-3-3	Staff	5	C--Periodic Speed Studies
	8-3-4	Staff	5	D--Truck Speed - Weight Study
11	9-1			Climatic Data
	9-1-1	Staff	1	A--Winter Weather 1935-51
12	2-7			Test Road No. 3
	2-7-1	Goetz, Shelburne*	2	A--Resurvey
	2-7-2	Chang*	2	B--Sample Tests
13	6-7	Belcher*	2	Test Rd. Sur. Treat.
14	6-8			Triaxial Tests
	6-8-1	Yoder	1	A--U. S. 41 Test Road
	6-8-2	Yoder, Wood, Hampton	2	B--Effect of Rate of Loading
	6-8-3	Gregg*	2	C--Soil and Soil Mixtures
15	6-9			Drainage
	6-9-1	McAlpin*	2	A--Small Models
	6-9-2	McClelland*	2	B--Large Models
	6-9-3	Ku*	2	C--Capillarity
	6-9-4	Hittle	3	D--Capillary Potential
	6-9-5	Robertson*	2	E--Permeability
	6-9-6		3	F--Agg. Grad. for Drains
	6-9-7	Slessor*	1	G--Soil-Vapor Press.
	6-9-8	Yeh	2	H--Hydrology
	6-9-9	Kashef*	2	I--Numerical Solution to Flow Problems

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
16	6-10			Field Soil Temp. and Moisture
	6-10-1	Yoder & Lowrie*	2	A--Field Installations
	6-10-2	Lennertz* & Lovell	3	B--Soil Temp. Gages
	6-10-3	Lovell	3	C--Soil Mois. Meas. Dev.
	6-10-4	Lovell	1	D--Freezing Index Maps
17	8-4			Traffic Engineering Research
	8-4-1	Green*	3	A--Signs
	8-4-2	Wilson*	2	B--Intersections
	8-4-3	Green*	3	C--Pvt. Usage
	8-4-4	O'Mara*	2	D--Accidents
	8-4-5	Quimby*	2	E--Effect of Narrow Bridges
	8-4-6	Overmyer*	2	F--Width, Pavement
	8-4-7	Baerwald*	2	G--Public Opinion Poll
	8-4-8	Lang*	2	H--Shoulders Influence
	8-4-9	Barkley*	2	I--Bibliography
	8-4-10	Baerwald*	3	J--Effect of Median Strip
	8-4-11	MacNaughton*	2	K--Turn Lane Controls
	8-4-12	Rosenfield*	2	L--Lateral Placement of Vehicles
	8-4-13	Baerwald*	1	M--Drive-In Theartre Traffic
	8-4-14	Powers*	2	N--Intersectional Delineation
	8-4-15	Jackman*	2	O--Driver Obedience to Signs
	8-4-16	Barr*	2	P--Scramble System
	8-4-17	Cooper*	2	Q--4-Way Stop
	8-4-18	Weckesser*	2	R--Edge Striping Effect on Lateral Placement
	8-4-19	Elmberg	5	S--Speed Zoning
18	5-4			Chert in Aggregate
	5-4-1	Sweet*	2	A--In Indiana
	5-4-2	Popovics	5	B--Method of Improving Durability
19	5-5			Concrete General
	5-5-1	Jones*	2	A--Phys. Characteristics
	5-5-2	Robertson*	1	B--Cores, U. S. No. 40
	5-5-3	Jones*	1	C--Fatigue
20	4-3			Salt Migration
	4-3-1	Slosser*	2	A--Laboratory
	4-3-2	Frost*	1	B--Route 30 Heave
	4-3-3	Frost*	1	C--Buffalo-Laporte
21	2-8			Local Aggregates
	2-8-1	Metcalf*	2	A--Sandstone
	2-8-2	Rice*	2	B--Sands
22	2-9			Bituminous Emulsions
	2-9-1	Tyler*	2	A--Bituminous Emulsions

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
23	5-6			Concrete Scaling
	5-6-1	Green*	3	A--Linseed Oil
	5-6-2	Green*	3	B--Field Studies
	5-6-3	Green*, Shelburne*	3	C--U. S. 20 Study
24	2-10			Bituminous Structure
	2-10-1	Bonewits*	2	A--Microscopic Technique
25	9-2			Dynamic Modulus
	9-2-1	Bawa*	2	A--Bit.-Agg. Mix.
	9-2-2	Whitehurst*	2	B--Time of Set
	9-2-3	Yong*	2	C--Sonic vs. Mech. Test of Bitum. Mix.
	9-2-4	Whitehurst*	2	D--Soil-Cement and Soil-Lime
	9-2-5	Whitehurst*	2	E--Field Use
26	4-4			Paints
	4-4-1	Goetz	2	A--Traffic Paints
	4-4-2	Goetz	1	B--Blackout Paints
	4-4-3	Goetz	3	C--Laboratory & Field
	4-4-4	Goetz	3	D--Bridge Paint
	4-4-5	Blackburn*, Dolch	2	E--Waterproofing
	4-4-6	Goetz	3	F--Prison Paints
27	6-11	Shelburne*	1	Test Road No. 4
28	9-3			Photoelasticity
	9-3-1	Woodsmall*	2	A--Subg. Stress
	9-3-2	Baker*	2	B--Calculations
	9-3-3	Hittle	1	C--Dowel Bars
	9-3-4	Hittle	1	D--Conc. Arch
29	1-3			Aerial Strip Maps
	1-3-1	Mettes*	3	A--Highway Locations
	1-3-2	Hittle	2	B--Use of Strip Maps
	1-3-3	Miles	2	C--Strip Map Location
30	9-4			Geology
	9-4-1	Woods, Yoder & Johnstone*	2	A--Preglacial Marietta River
31	2-11			Bituminous Performance
	2-11-1	Shelburne*	1	A--Route 26
	2-11-2	Shelburne*	1	B--Route 17
	2-11-3	McLaughlin, Goetz	3	C--Bituminous Concrete Stability
	2-11-4	Shelburne*	1	D--Spring Breakup 1943
	2-11-5	Green*	1	E--Spring Breakup 1945
	2-11-6	Goetz	1	F--Spring Breakup 1951

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
32	1-4			Airphoto Interpretation
	1-4-1	Belcher*	2	A--Granular Materials
	1-4-2	Frost*	3	B--Rough Topography
	1-4-3	Parvis	3	C--Airphoto Bibliography
	1-4-4	Frost*	1	D--Use in Location
	1-4-5	Parvis	2	E--Use in Drainage
	1-4-6	Montano*	3	F--Indiana Soils-Northern
	1-4-7	Frost*	3	G--Indiana Soils-Southern
	1-4-8	Frost*	1	H--U. S. 40, Terre Haute
	1-4-9	Mollard*	1	I--Valparaiso Moraine
	1-4-10	Nishimura*	2	J--Erie Moraines
	1-4-11	Howe*	2	K--Ground Water
	1-4-12	Miles	2	L--Topographic Mapping
	1-4-13	Bailey*	2	M--Mapping for Preliminary Location
	1-4-14	Parvis	5	N--Determination of Runoff
	1-4-15	Johnson	5	O--Measurement of Final Quantities
33	6-12	McAlpin* Belcher*	1	Test Road No. 5
34	6-13	Belcher*	1	Test Road No. 6
35	5-7			Conc. Performance
	5-7-1	Shelburne*	1	A--Route 67
	5-7-2	Tung*	1	B--Route 29
	5-7-3	Shelburne*	1	C--Route 6
	5-7-4	Shelburne*	1	D--Route 30
	5-7-5	Shelburne*	1	E--Roughness
	5-7-6	Camp*	1	F--U. S. No. 50
36	6-14			Indiana Soil Problems
	6-14-1	Hampton	5	A--Statistical Analysis of Soil Sampling
	6-14-2	Lennertz*	2	B--Geophysical Testing
	6-14-3	Larew*	2	C--Landslides
	6-14-4	Woods	2	D--Soil Surveys
	6-14-5	Shurig	2	E--Subsurface Exploration
	6-14-6	Moore*	2	F--Airphoto Evaluation
37	5-8			Conc. Durability
	5-8-1	Shelburne*	3	A--Curing
	5-8-2	Sweet*, Woods	2	B--Base Courses
	5-8-3	Soon*	3	C--Aggregate Absorption
	5-8-4	Lewis*, Sweet*	3	D--Sonic-Lab.
	5-8-5	Lewis*, Sweet*	3	E--Sonic Field
	5-8-6	Glover*, Lu*	3	F--Coef. Expansion
	5-8-7	Bugg*	2	G--Air Entrn. Admixtures
	5-8-8	Blackburn*	2	H--Disintegration Bibliography
	5-8-9	Pendley*	2	I--Restraint Effects

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	5-8-10	Lu*	2	J--Therm. Shock
	5-8-11	Fears*	2	K--Pore Charac.
	5-8-12	Higgs*, McLaughlin	3	L--Fine Aggregate
	5-8-13	Blackburn*	2	M--Agg. Dur. in Air-Entr. Conc.
	5-8-14	Barkley*	3	N--Concr. Admix.
	5-8-15	Batchelder*	2	O--Strength and Dynamic Properties
	5-8-16	Venters*, Lewis*, McLaughlin	2	P--Gravel, Non-durable Constituents
	5-8-17	Batchelder*, Fears*	2	Q--Air Content, Hardened Concrete
	5-8-18	Lewis*, Whitehurst* McLaughlin	5	R--Bridge Concrete, Deterioration
	5-8-19	Lewis*, Irick* Blackburn*	2	S--Variability of Durability Tests
	5-8-20	Walker	2	T--Gravel-Stone Mixt.
	5-8-21	McLaughlin	2	U--HRB Cooperative Study
	5-8-22	McLaughlin	3	V--Dur. Pre-Stressed Conc.
	5-8-23	McLaughlin	3	W--Air-Entr. Conc. Pave. Survey
	5-8-24	McLaughlin	5	X--Freeze Thaw Tests
	5-8-25			Y--
	5-8-26	Dolch	5	Z--Dampproofing Treatment of Bridges
38	6-15			Soil Mapping
	6-15-1	Frost*, Hittle	2	A--Field and Lab.
	6-15-2	Frost*	1	B--Route 20
	6-15-3	Frost*	1	C--U. S. No. 31
39	7-3			Highway Loading
	7-3-1	Woods	2	A--Loading and Design Trends
40	6-16	Belcher*	1	Test Road 7
41	4-5			Plastics
	4-5-1	Yehalem*	2	A--Durability
	4-5-2	Lewis*	2	B--Strength
	4-5-3	Slate*	3	C--New Plastic & Signs
	4-5-4	Slate*	2	D--Centerline Markings
42	5-9			Aggregate Survey
	5-9-1	Sweet*	2	A--Significance of Tests
	5-9-2	Woods	2	B--Origin & Destr.
	5-9-3	Fears*	2	C--Biblio. Aggreg.
	5-9-4	Lewis*, McLaughlin	3	D--Specifications
	5-9-5	Lewis*, McLaughlin, Schuster	1	E--Indiana Sources
	5-9-6	McLaughlin, Schuster	5	F--Further Studies of Deleterious Substances

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
43	6-17			Pedological Soils
	6-17-1		3	A--St. Dens. Proctor
	6-17-2	Hittle	3	B--Typ. Proctor Curves
44	5-10			Concrete Pumping
	5-10-1	Green*	2	A--Field Surveys, 1943 and 1947
	5-10-2	Shelburne*, Green*	2	B--Pvt. Jack
	5-10-3	Goetz, Green*	2	C--Pumping Mixtures
	5-10-4	Goetz	3	D--Rig. Pvt. Salvage
	5-10-5	Lewis*	1	E--1951 Survey
	5-10-6	Lewis*	1	F--1954 Survey
45	6-18			Base Courses
	6-18-1	Yoder	2	A--Gran. Bases-Lab.
	6-18-2	Henderson*	2	B--U. S. 30 Bases
	6-18-3	Soon*	1	C--Temp. vs. Compaction
	6-18-4	Pollard*	3	D--Sand-Clay Distribution
	6-18-5	McCullough*	3	E--Ind. Sand-Clay Characteristics
	6-18-6	Yoder & Irick*	3	F--Rigid Pavement on Gran. Base
46	5-11			Conc. Pvt. Design
	5-11-1	Shelburne*	1	A--Deflection Stud.
	5-11-2	Sweet* & Woods	2	B--Blowup Survey-Perf.
	5-11-3	Hittle	1	C--Thin Pvt. Surv.
	5-11-4	Lewis*	2	D--Resurf. Pvt. Surv.
	5-11-5	Lewis*	1	E--Joint Perf. Surv.
	5-11-6	Lewis*	1	F--Load Trans. Device
	5-11-7	Camp*	1	G--Conc. Exp.
	5-11-8	Melville*	1	H--Conc. Exp.
	5-11-9	Okamoto*	1	I--Freeze and Thaw
	5-11-10	Lewis*	1	J--Resurvey of Blowups
	5-11-11	Schnebeli* Thoma*& Lewis*	3	K--Strain Gauges
	5-11-12	Choksi*	2	L--Structural Design Bibliography
	5-11-13	Miller*	2	M--Theoretical Strains & Stresses
47	4-6			Chemistry of Concrete
	4-6-1	Slate*	3	A--Gels
	4-6-2		3	B--Thin Sections
	4-6-3	Dolch	3	C--Solubility of Aggregates
	4-6-4	Slate*	2	D--Bibliography
	4-6-5	Fox*	2	E--Thermal
	4-6-6	Dolch	2	F--Aggr. Voids
	4-6-7	Dolch	2	G--Alkali Aggregate Reaction
48	9-5			Turf Studies
	9-5-1	Yoder	2	A--Early Studies

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
49				
50	6-19			Soil Stabilization
	6-19-1	Slesser*	1	A--Chemical
	6-19-2	Hills*	1	B--Molasses
	6-19-3	Johnson*, Dolch, & Yoder	1	C--Lime
	6-19-4	Sharma*	2	D--Bibliography
	6-19-5	Korman*	2	E--Soil Cal. Chloride Mix
	6-19-6	Yoder	1	F-- Test Road Using DDAC
51	1-5			Soil, Drainage Mapping
	1-5-1	Parvis, Yeh, Magnusson*	5	A--Drainage Maps
	1-5-2	Montano*, Yeh	5	B--Soils Maps
	1-5-3	Moultrop*	2	C--Loess Mapping
	1-5-4	McLerren*	2	D--SW Indiana Interbedded Shale
	1-5-5			E--
	1-5-6	Stylianopoulous*	2	F--SS and Shale of SW Indiana
	1-5-7	Robbins*	3	G--LS and Shale of SE Indiana
	1-5-8	Leighty*	2	H--Alluvial Terraces
	1-5-9	McGregor*	2	I--Agriculture Soil Map Use
	1-5-10	Yeh	5	J--State Drainage Map
	1-5-11	Montano*, Yeh	2	K--State Soils Map
	1-5-12	Dawson*	2	L--SS and Shale of SC Indiana
	1-5-13	Van Til*	2	M--LS of SC Indiana
	1-5-14	Stevens*	2	N--Illinoian Glacial Drift, SE Indiana
	1-5-15	Johnson*	2	O--Northern Indiana Sands
	1-5-16	Richert*	2	P--SS and Shale Areas
	1-5-17	Davis*	2	Q--NW Indiana Moraines
	1-5-18	Mintzer*	2	R--Illinoian Glacial Drift, SW Indiana
52	6-20			Pavement Design
	6-20-1	Ardaman* & Yoder	2	A--C.B.R. Tests
	6-20-2	Yoder	5	B--Flexible Pavement Design
	6-20-3	Walker	5	C--Deflection U. S. 31 Test Road
	6-20-4	McMahon*	5	D--Soil Pressures under Flexible Pvts.
	6-20-5	Walker	3	E-- Repetitive Loading Tests
	6-20-6	Ruth & Yoder	5	F--Interaction of Variables on Stresses
53	9-6			Road Roughness & Skid
	9-6-1	Metcalf*, Thanos* Holloway*	2	A--Equipment, Roughness
	9-6-2	Grunau*, Baerwald*	2	B--Skid Resistance Equipment
	9-6-3	McLaughlin	1	C--Skid Characteristics Bibliography

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	9-6-4	Shupe*	2	D--Bit. Mixture Skid Characteristics
	9-6-5	Grunau*, Michael, Shupe*	2	E--Skid Resistance of U. S. 31 Test Rd.
	9-6-6	Rosenfield* Weckesser*	2	F--Lateral Placement of U. S. 31 Test Rd.
	9-6-7	Grunau*, Michael	2	G--Skidding Characteristics, Ind.
	9-6-8	Grunau*, Shupe*	2	H--Skid Tests on U. S. 421
	9-6-9	Holloway*	2	I--Roughness Characteristics
	9-6-10	Stephens*	5	J--Effects of Aggregate on Skidding
54	3-3			Econ. & Admin.
	3-3-1	Michael	3	A--Wabash River Bridge
	3-3-2	May*	2	B--Lebanon Bypass
	3-3-3	Michael	2	C--Kokomo Bypass
	3-3-4	Baerwald*	2	D--Public Opinion Poll
	3-3-5	Branham, Baerwald*	2	E--County Road Marking
	3-3-6	Branham, Baerwald*	3	F--Cost Allocation
	3-3-7	May* & Yoder	3	G--Air Transportation
	3-3-8	May*	3	H--Laf. Trans. Study
	3-3-9	May*	2	I--Logansport Study
	3-3-10	Michael	2	J--Richmond Study
	3-3-11	Michael	3	K--Bloomington Study
	3-3-12	Bauer*	3	L--Logansport Parking
	3-3-13	Kell*	2	M--O-D Surv. Methods
	3-3-14	Stoner*, Petty, Woods & Branham	2	N--Co. Highway Admin.
	3-3-15	Miller*	2	O--Sampling Techniques
	3-3-16	Baerwald*	2	P--County Classification
	3-3-17	Michael & Edwards*	2	Q--Huntington Survey
	3-3-18	Baerwald*	2	R--Allen Co. Study
	3-3-19	Branham	2	S--Recruitment of Engineers
	3-3-20	Michael	2	T--State Highway Needs Study
	3-3-21	May*	2	U--Evaluation of Limited Access Highways
	3-3-22	Barr*	2	V--Urban Characteristics for O-D Surveys
	3-3-23	Cribbins	2	W--Northern Indiana Seaport
	3-3-24	Branham	2	X--Engineer Retention Study
	3-3-25	Kask*	2	Y--W. Lafayette Shopping Center Study

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
	3-3-26	Pinnell*	2	Z--Bypass Reevaluation Studies
	3-3-27	Covault*	2	AA--Sampling for County Needs
55	2-12			Flex. Pavement Design
	2-12-1	Goetz	5	A--General
	2-12-2	Lowrie*	2	B--Design
	2-12-3	Metcalf*	3	C--Test Road, Churubusco
	2-12-4	Herrin*	3	D--Thickness Design
	2-12-5	McLaughlin, Goetz	5	E--Bituminous Concrete
	2-12-6	Goetz, Gaudette	5	F--U. S. 31 Test Road Cores
56	7-4			Bridges
	7-4-1	McCammon*	3	A--Dynamic Forces
	7-4-2	Hayes, Sbarounis*	2	B--Vibration
	7-4-3		3	C--Soil Pressure, U-Type Bridge
	7-4-4			D--
	7-4-5	Wyly*	3	E--Design of Washers for High Tensile Bolts
	7-4-6	Antrim	2	F--Fatigue Properties
	7-4-7	Gray	5	G--Fatigue Properties, Light Weight Concrete
57	5-12			Cement
	5-12-1	Blackburn*	1	A--Slag Cement, Durability of Concrete
58	5-13			Prestressed Concrete
	5-13-1	Midgaard*	2	A--Creep & Shrinkage
	5-13-2	Nordby*	3	B--Endurance, Fatigue
	5-13-3	Musleh*	2	C--Freeze & Thaw Affects
59	8-5			Traffic Safety
	8-5-1	Michael	3	A--Crash Injury
	8-5-2	Michael	3	B--Safety Belts
	8-5-3	Woo*	2	C--Accident Rate vs. Design Features
	8-5-4	Blindauer*	2	D--High Accident Rates
	8-5-5	Stover	5	E--Locating Slippery Pavements from Accident Reports
60	3-4			Highway Cost Studies
	3-4-1	Belcher*	1	A--Mass Diagram
	3-4-2	Mylroie*	3	B--Receipts and Disbursements, N. C. States

Project C-36	File No.	Assigned to	Status (See Key)	Title of Project
61	5-14			Concrete Characteristics
	5-14-1	McLaughlin	3	A--Temp. Effect on Air Bubble Distribution
62	9-8			Hydraulics
	9-8-1	Delleur	5	A--Runoff from Small Drainage Areas
	9-8-2	Delleur, Owen, Sooky, Husain*	5	B--Hydraulics of Arch Bridges
63	9-7			Pavement Deflection
	9-7-1	Geldmacher*, Anderson*, Dunkin*, Wood*, Harr*	2	A--Pavement Deflection
	9-7-2	Harr*	2	B--Environmental Effects
	9-7-3	Bell	5	C--Measurement of Moisture in Concrete

EXTRA LABOR EMPLOYEES

Supplement No. 5*

Termination Between July 1, 1958 and June 30, 1959

Employee	Employed	Resigned
Abe, I.	4-15-59	5-31-59
Akinwumi, Alfred	7-1-58	11-15-58
Allen, R. K.	9-16-58	5-31-59
Armuth, Deen	8-1-58	2-16-59
Bellamy, L. A.	9-16-58	5-15-59
Bhatia, H.	11-1-58	12-31-58
Biery, F.	8-1-58	6-30-59
Bishop, G. W.	2-1-59	6-15-59
Brugos, D.	9-16-58	5-31-59
Busch, L. O.	3-30-59	3-31-59
Chastain, L. E.	2-15-59	5-31-59
Cherry, L.	8-16-58	11-15-58
Daley, R. A.	3-5-59	5-30-59
Denney, M. L.	3-15-59	3-30-59
Dogue, R.	7-1-58	5-15-59
Faeth, Mary	10-1-58	11-15-58
Fouch, N.	9-16-58	10-15-58
Fung, J.	9-1-58	12-15-58
Garatoni, L. H.	3-15-59	5-15-59
Halicki, R. Jr.	3-23-59	5-15-59
Harris, P.	7-1-58	11-15-58
Hiranandani, H. R.	7-1-58	8-30-58
Holtz, T. W.	10-15-58	12-15-58
Hoover, W.	2-23-59	2-25-59
Houmard, J.	7-15-58	8-31-58
Jackson, [illegible]	8-1-58	11-15-58
Jensen, J.	7-16-58	8-31-58
Jones, Elizabeth	8-1-58	8-15-58
Jouzy, N.	9-15-58	2-2-59
Kater, John	7-1-58	6-30-59
Khaja, F.	11-1-58	11-15-58
Lake, W. R. Jr.	8-1-58	7-15-58
Lauer, K. R.	8-15-58	9-30-58
Levy, William	8-15-58	8-30-58
Lill, P.	7-1-58	5-15-59
Lippai, S.	3-1-59	3-31-59

Employees	Employed	Resigned
Manuel, R.	9-15-58	5-15-59
Mason, B. H.	5-1-59	5-30-59
Mendenhall, G.	8-1-58	8-15-58
Mines, R.	8-15-58	10-15-58
Modi, J.	10-1-58	1-31-59
Montibon, S. S.	6-1-59	6-15-59
Motwani, D. L.	1-16-58	7-15-58
Musleh, F.	7-15-58	8-30-58
Noffal, G.	8-15-58	2-22-59
Owen, D.	11-16-58	11-30-58
Paul, J.	9-15-58	5-15-59
Peterson, B.	4-9-59	5-15-59
Pierce, J.	11-16-58	11-30-58
Pitman, T. C.	2-14-59	5-15-59
Replogle, C. E.	8-15-58	11-15-58
Santner, U.	7-16-58	8-15-58
Sarna, S. D.	7-16-58	9-16-58
Sasano, C.	10-1-58	2-2-59
Smith, Eleanor	7-1-58	8-30-58
Smith, George	7-1-58	11-15-58
Steele, J. J.	9-15-58	5-15-59
Stewart, Morris	9-15-58	2-2-59
Surber, R.	7-1-58	5-15-59
Taha, I.	7-1-58	8-30-58
Timm, C. M.	4-23-59	5-15-59
Van Sickle, J.	9-15-58	6-15-59
Walters, W.	8-1-58	2-28-59
Wang, D. C.	2-1-59	6-15-59
Weidner, R.	7-1-58	5-30-59
Whitney, J. R.	12-1-58	2-15-59
Worden, Nancy	8-1-58	11-15-58
Yaste, J.	9-15-58	10-31-58
Yunibhand, S.	7-1-58	9-30-58

* For listing of all terminations prior to July 1, 1954, see the "Annual Report of the Associate Director for 1953-54". For terminations after July 1, 1954 see the Annual Reports of the Assistant Director for 1954-1955, 1955-1956, 1956-1957, and 1957-1958.

Still Employed on July 1, 1959

Employee	Employed
Aksh, Z.	7-15-58
Andrews, P. R.	7-1-58
Bergman, P.	2-16-59
Chambers, B. B.	6-1-59
Crabtree, B. L.	4-27-59
Day, J. A.	8-15-58
Desrosier	9-1-58
Diskerud, T. C.	6-16-59
Egyed, A. N.	9-16-58
Garrett, C.	7-1-58
Hamilton, R. R.	4-6-59
Hanssen, L. N.	6-1-59
Kerckaert, E. J.	6-1-59
Morton, C. V.	12-16-58
Nakashima, R. Y.	6-1-59
Reddy, A. S.	6-1-59
Shah, G. N.	3-30-59
Syran, S.	6-16-59
Tsongos, Nick	7-1-58